(2)

The Department of Defense

DoD DEPARTMENTS/AGENCIES:

Department of the Army

Department of the Navy

Department of the Air Force

DARPA — Defense Advanced Research Projects Agency

Defense Nuclear Agency

Strategic Defense Initiative Organization

PROGRAM SOLICITATION 93.1
CLOSING DATE: 15 JANUARY 1993

FY 1993 SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM

NATIONAL SBIR CONFERENCES

FEDERAL R&D OPPORTUNITIES
FOR
TECHNOLOGY INTENSIVE FIRMS

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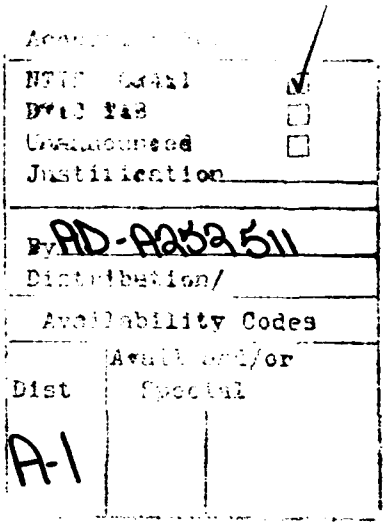
For Registration or Further Information:
Contact Foresight Science & Technology, Inc.
Hotline (407) 274-4005 Contractor to NSF/DOD

PROGRAM SOLICITATION

Number 93.1

Small Business
Innovation
Research Program

U.S. Department of Defense
SBIR Program Office
Washington, DC 20301



Closing Date: JANUARY 15, 1993

Deadline for receipt of proposals at the DoD Component is 2:00 p.m. local time.

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DoD PROGRAM SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH

1.0 PROGRAM DESCRIPTION

1.1 Introduction

The Army, Navy, Air Force, Defense Advanced Research Projects Agency (DARPA), Defense Nuclear Agency (DNA), and Strategic Defense Initiative Organization (SDIO) hereafter referred to as DoD Components, invite small business firms to submit proposals under this program solicitation entitled Small Business Innovation Research (SBIR). Firms with strong research and development capabilities in science or engineering in any of the topic areas described in Section 8.0 are encouraged to participate. Subject to availability of funds, DoD Components will support high quality research or research and development proposals of innovative concepts to solve the listed defense-related scientific or engineering problems.

Objectives of the DoD SBIR Program include stimulating technological innovation, strengthening the role of small business in meeting DoD research and development needs, fostering and encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DoD-supported research or research and development results.

The Federal SBIR Program is mandated by Public Laws PL 97-219 and PL 99-443. The basic design of the DoD SBIR Program is in accordance with the Small Business Administration (SBA) SBIR Policy Directive, June 1988. The DoD Program presented in this solicitation strives to encourage scientific and technical innovation in areas specifically identified by DoD Components. The guidelines presented in this solicitation incorporate and exploit the flexibility of the SBA Policy Directive to encourage proposals based on scientific and technical approaches most likely to yield results important to DoD.

1.2 Three Phase Program

This program solicitation is issued pursuant to the Small Business Innovation Development Act of 1982, PL 97-219 and PL 99-443. Phase I is to determine, insofar as possible, the scientific or technical merit and feasibility of ideas submitted under the SBIR Program and will typically be one half-person year effort over a period not to exceed six months. Proposals should concentrate on that research or research and development which will significantly contribute to proving the scientific and technical feasibility of the proposed effort, the successful completion of which is a prerequisite for further DoD support in Phase II. The measure of Phase I success includes evaluations of the extent to which Phase II results have the potential to yield a product or process of continuing importance to DoD. Proposers are asked to consider whether the research and development they are proposing to DoD Components also has commercial possibilities, either for the proposed application or as a base for other applications. If it appears to have such potential, proposers are encouraged, on an optional basis, to obtain a contingent commitment for private follow-on funding to pursue further development of the commercial potential after the government funded research and development phases.

Subsequent Phase II awards will be made to firms on the basis of results from the Phase I effort and the scientific and technical merit of the Phase II proposal. Phase II awards will typically cover 2 to 5 person-years of effort over a period generally not to exceed 24 months (subject to negotiation). Phase II is the principal research or research and development effort and is expected to produce a well-defined deliverable product or process. A more comprehensive proposal will be required for Phase II.

Under Phase III, the small business is expected to use non-federal capital to pursue commercial applications of the research or development. Also, under Phase III, federal agencies may award non-SBIR funded follow-on contracts for products or processes which meet the mission needs of those agencies. This solicitation is designed, in part, to provide incentives for the conversion of federally sponsored research and development innovation in the private sector. The federal research and development can serve as both a technical and pre-venture capital base for ideas which may have commercial potential.

This solicitation is for Phase I proposals only. Any proposal submitted under prior SBIR solicitations will not be considered under this solicitation; however, offerors who were not awarded a contract in response to a particular topic under prior SBIR solicitations are free to update or modify and submit the same or modified proposal if it is responsive to any of the topics listed in Section 8.0 hereof.

For Phase II, no separate solicitation will be issued. Only those firms that were awarded Phase I contracts will be considered (Section 4.3 and 5.2).

DoD is not obligated to make any awards under either Phase I, II, or III. DoD is not responsible for any monies expended by the proposer before award of any contract.

1.3 Follow-On Funding

In addition to supporting scientific and engineering research and development, another important goal of the program is conversion of DoD-supported research or research and development into technological innovation by private firms. Therefore, on an optional basis, the DoD Program includes an incentive for proposers to obtain a contingent commitment for private follow-on funding prior to Phase II to continue the innovation process where it is felt that the research or research and development also have commercial potential.

Proposers who feel that their research or research and development have the potential to meet private sector market needs, in addition to meeting DoD objectives, are encouraged to obtain non-federal follow-on funding for Phase III to pursue commercial development. The commitment should be obtained during the course of Phase I performance. This commitment may be contingent upon the DoD supported research or development meeting some specific technical objectives in Phase II which if met, would justify non-federal funding to pursue further development for commercial purposes in Phase III. *Note that when several Phase II proposals receive evaluations being of approximately equal merit, proposals that demonstrate such a commitment for follow-on funding will receive extra consideration during the evaluation process.*

The recipient will be permitted to obtain commercial rights to any invention made in either Phase I or Phase II, subject to the patent policies as stated in Section 5.7.

1.4 Eligibility and Limitation

Each proposer must qualify as a small business for research or research and development purposes as defined in Section 2.0 and certify to this on the Cover Sheet (Appendix A) of the proposal. In addition, a minimum of two-thirds of each Phase I SBIR project must be carried out by the proposing firm. For Phase II, a minimum of one-half of the effort must be performed by the proposing firm. For both Phase I and II, the primary employment of the principal investigator must be with the small business firm at the time of the award and during the conduct of the proposed effort. Primary employment means that more than one-half of the principal investigator's time is spent with the small business. Deviations from these requirements must be approved in writing by the contracting officer (during contract negotiations).

For both Phase I and Phase II, the research or research and development work must be performed by the small business concern in the United States. "United States" means the fifty states, the Territories and possessions of the United States, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, the Trust Territory of the Pacific Islands, and the District of Columbia.

Joint ventures and limited partnerships are permitted, provided that the entity created qualifies as a small business in accordance with the Small Business Act, 15 USC 631, and the definition included in Section 2.2.

1.5 Conflicts of Interest

Awards made to firms owned by or employing current or previous Federal Government employees could create conflicts of interest for those employees in violation of 18 USC and 10 USC 2397. Such proposers should contact the cognizant Ethics Counsellor of the DoD Component for further guidance.

1.6 Contact with DoD

a. General Information. General information questions pertaining to proposal instructions contained in this solicitation should be directed to:

Mr. Bob Wrenn
SBIR Coordinator
OSD/SADBU
U.S. Department of Defense
The Pentagon - Room 2A340
Washington, DC 20301-3061
(703) 697-1481

Other non-technical questions pertaining to a specific DoD Component should be directed in accordance with instructions given at the beginning of that DoD Component's topics in Section 8.0 of this solicitation. Oral communications with DoD Components regarding the technical content of this solicitation during the Phase I proposal preparation periods are prohibited for reasons of competitive fairness.

b. Requests for Additional Copies of This Solicitation. Additional copies of this solicitation may be ordered from:

Defense Technical Information Center
Attn: DTIC/SBIR
Building 5, Cameron Station
Alexandria, Virginia 22304-6415
(800) 225-3842 toll free
(703) 274-6903 commercial

c. Outreach Program. The DoD holds three National SBIR Conferences a year (see Reference) and participates in many state-organized conferences for small business. We have a special outreach effort to minority and disadvantaged firms and to small companies that are negatively affected by the Defense down-sizing.

2.0 DEFINITIONS

The following definitions apply for the purposes of this solicitation:

2.1 Research or Research and Development

Basic Research - A systematic, intensive study directed toward greater knowledge or understanding of the subject studied.

Exploratory Development - A systematic study directed specifically toward applying new knowledge to meet a recognized need.

Advanced Development or Engineering Development - A systematic application of knowledge towards the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.

2.2 Small Business

A small business concern is one that, at the time of award of a Phase I or Phase II contract:

a. Is independently owned and operated and organized for profit, is not dominant in the field of operation in which it is proposing, and has its principal place of business located in the United States;

b. Is at least 51% owned, or in the case of a publicly owned business, at least 51% of its voting stock is owned by United States citizens or lawfully admitted permanent resident aliens;

c. Has, including its affiliates, a number of employees not exceeding 500, and meets the other regulatory requirements found in 13 CFR 121. Business concerns, other than investment companies licensed, or state development companies qualifying under the Small Business Investment Act of 1958, 15 USC 661, et seq., are affiliates of one another when either directly or indirectly (1) one concern controls or has the power to control the other; or (2) a third party or parties controls or has the power to control both. Control can be exercised through common ownership, common management, and contractual relationships. The term "affiliates" is defined in greater detail in 13 CFR 121.3-2(a). The term "number of employees" is defined in 13 CFR 121.3-2(t). Business concerns include, but are not limited to, any individual, partnership, corporation, joint venture, association or cooperative.

2.3 Minority and Disadvantaged Small Business

A small business that is at the time of award of a Phase I or Phase II contract:

a. At least 51% owned by one or more minority and disadvantaged individuals; or, in the case of any publicly owned business, at least 51% of the voting stock of which is owned by one or more minority and disadvantaged individuals; and

b. Whose management and daily business operations are controlled by one or more of such individuals.

A minority and disadvantaged individual is defined as a member of any of the following groups: Black Americans, Hispanic Americans, Native Americans, Asian-Pacific Americans, or subcontinent-Asian Americans.

2.4 Women-Owned Small Business

A women-owned small business is one that is at least 51% owned by a woman or women who also control and operate it. "Control" in this context means exercising the power to make policy decisions. "Operate" in this context means being actively involved in the day-to-day management.

2.5 Subcontract

A subcontract is any agreement, other than one involving an employer-employee relationship, entered into by a Federal Government contract awardee calling for supplies or services required solely for the performance of the original contract. This includes consultants.

3.0 PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS

3.1 Proposal Requirements

A proposal to any DoD Component under the SBIR Program is to provide sufficient information to persuade the DoD Component that the proposed work represents an innovative approach to the investigation of an important scientific or engineering problem and is worthy of support under the stated criteria.

The quality of the scientific or technical content of the proposal will be the principal basis upon which proposals will be evaluated. The proposed research or research and development must be responsive to technological innovation, and new commercial products, process, or services which benefit the public.

Those responding to this solicitation should note the proposal preparation tips listed below:

- Read and follow all instructions contained in this solicitation.
- Use the free technical information services from DTIC and other information assistance organizations (Section 7.1 - 7.4).
- Mark proprietary information as instructed in Section 5.5.
- Limit your proposal to 25 pages.
- Use a type size no smaller than 12 pitch or 11 point.
- Don't include proprietary or classified information in the project summary (Appendix B).
- Include a Red Copy of Appendix A and Appendix B as part of the Original of each proposal.
- Do not use a proportionally spaced font on Appendix A and Appendix B.

3.2 Proprietary Information

If information is provided which constitutes a trade secret, proprietary, commercial or financial information, confidential personal information, or data affecting the national security, it will be treated in confidence to the extent permitted by law, provided it is clearly marked in accordance with Section 5.5.

3.3 Limitations on Length of Proposal

This solicitation is designed to reduce the investment of time and cost to small firms in preparing a formal proposal. Those who wish to respond must submit a direct, concise, and informative research or research and development proposal of no more than 25 pages (no type smaller than 11 point or 12 pitch on standard 8½" X 11" paper with one (1) inch margins, 6 lines per inch), *including Proposal Cover Sheet (Appendix A), Project Summary (Appendix B), Cost Proposal (Appendix C), and any enclosures or attachments.* Promotional and non-project related discussion is discouraged. Cover all items listed below in Section 3.4 in the order given. The space allocated to each will depend on the problem chosen and the principal investigator's approach. In the interest of equity, proposals in excess of the 25-page limitation (including attachments, appendices, or references) will not be considered for review or award.

The proposal must address the research or research and development proposed on the specific topic chosen. It is not necessary to provide a lengthy discourse on the commercial applications in the Phase I proposal except to discuss briefly as described in Section 3.4, items b and h.

3.4 Phase I Proposal Format

All pages shall be consecutively numbered and the ORIGINAL of each proposal must contain a completed red copy of Appendix A and Appendix B.

a. Cover Sheet. Complete RED COPY of Appendix A, photocopy the completed form, and use a copy as Page 1 of each additional copy of your proposal.

b. Project Summary. Complete RED COPY of Appendix B, photocopy the completed form, and use a copy as Page 2 of each additional copy of your proposal. The technical abstract should include a brief description of the project objectives and description of the effort. Anticipated benefits and commercial applications of the proposed research or research and development should also be summarized in the space provided. The Project Summary of successful proposals will be submitted for publication with unlimited distribution and, therefore, will not contain proprietary or classified information.

c. Identification and Significance of the Problem or Opportunity. Define the specific technical problem or opportunity addressed and its importance. (Begin on Page 3 of your proposal.)

d. Phase I Technical Objectives. Enumerate the specific objectives of the Phase I work, including the questions it will try to answer to determine the feasibility of the proposed approach.

e. Phase I Work Plan. Provide an explicit, detailed description of the Phase I approach. The plan should indicate what is planned, how and where the work will be carried out, a schedule of major events, and the final

product to be delivered. Phase I effort should attempt to determine the technical feasibility of the proposed concept. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the total proposal.

f. Related Work. Describe significant activities directly related to the proposed effort, including any conducted by the principal investigator, the proposing firm, consultants, or others. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The proposal must persuade reviewers of the proposer's awareness of the state-of-the-art in the specific topic. Use of DTIC is encouraged.

g. Relationship with Future Research or Research and Development.

(1) State the anticipated results of the proposed approach if the project is successful.
(2) Discuss the significance of the Phase I effort in providing a foundation for Phase II research or research and development effort.

h. Potential Post Applications. Briefly describe:

(1) Whether and by what means the proposed project appears to have potential use by the Federal Government.
(2) Whether and by what means the proposed project appears to have potential commercial (private sector) application.

i. Key Personnel. Identify key personnel who will be involved in the Phase I effort including information on directly related education and experience. A concise resume of the principal investigator, including a list of relevant publications (if any), must be included.

j. Facilities/Equipment. Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Items of equipment to be purchased (as detailed in Appendix C) shall be justified under this section. Also state whether or not the facilities where the proposed work will be performed meet environmental laws and regulations of federal, state (name) and local governments for, but not limited to, the following groupings: airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal practices, and handling and storage of toxic and hazardous materials.

k. Consultants. Involvement of university or other consultants in the project may be appropriate. If such involvement is intended, it should be described in detail and identified in Appendix C. A minimum of <u>two-thirds</u> of each Phase I SBIR project must be carried out by the proposing firm, unless otherwise approved in writing by the contracting officer.

l. Prior, Current, or Pending Support. If a proposal submitted in response to this solicitation is substantially the same as another proposal that has been, is funded by, or is pending with another federal agency or DoD Component or the same DoD Component, the proposer must indicate action on Appendix A and provide the following information:

(1) Name and address of the federal agency(s) or DoD Component to which a proposal was submitted, will be submitted, or from which an award is expected or has been received.
(2) Date of proposal submission or date of award.
(3) Title of proposal.
(4) Name and title of principal investigator for each proposal submitted or award received.
(5) Title, number, and date of solicitation(s) under which the proposal was submitted, will be submitted, or under which award is expected or has been received.
(6) If award was received, state contract number.
(7) Specify the applicable topics for each SBIR proposal submitted or award received.

Note: If Section 3.4.1 does not apply, state in the proposal "No prior, current, or pending support for proposed work."

m. Cost Proposal. Complete the cost proposal in the form of Appendix C for the Phase I effort only. Some items of Appendix C may not apply to the proposed project. If such is the case, there is no need to provide information on each and every item. What matters is that enough information be provided to allow the DoD Component to understand how the proposer plans to use the requested funds if the contract is awarded.

(1) List all key personnel by <u>name</u> as well as by number of <u>hours</u> dedicated to the project as direct labor.
(2) Special tooling and test equipment and material cost may be included under Phases I and II. The inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the government and should be related directly to the specific topic. These may include such items as innovative instrumentation and/or automatic test equipment. Title to property furnished by the government or acquired with government funds will be vested with the DoD Component, unless it is determined that transfer of title to the contractor would be more cost effective than recovery of the equipment by the DoD Component.

(3) Cost for travel funds must be justified and related to the needs of the project.
(4) Cost sharing is permitted for proposals under this solicitation; however, cost sharing is not required nor will it be an evaluation factor in the consideration of a proposal.

3.5 Bindings

Do not use special bindings or cover. Staple the pages in the upper left hand corner of each proposal.

3.6 Phase II Proposal

A Phase II proposal can be submitted only by a Phase I awardee; that is, Phase II is not initiated by a solicitation. Each proposal must contain a Red Cover Sheet (Appendix A) and a Red Project Summary Sheet (Appendix B) of this solicitation. Copies of Appendices along with instructions regarding Phase II proposal preparation and submission will be provided by the DoD Components to all Phase I winners at time of Phase I contract award.

4.0 METHOD OF SELECTION AND EVALUATION CRITERIA

4.1 Introduction

Phase I proposals will be evaluated on a competitive basis and will be considered to be binding for six (6) months from the date of closing of this solicitation unless offeror states otherwise. If selection has not been made prior to the proposal's expiration date, offerors will be requested as to whether or not they want to extend their proposal for an additional period of time. Proposals meeting stated solicitation requirements will be evaluated by scientists or engineers knowledgeable in the topic area. Proposals will be evaluated first on their relevance to the chosen topic. Those found to be relevant will then be evaluated using the criteria listed in Section 4.2. Final decisions will be made by the DoD Component based upon these criteria and consideration of other factors including possible duplication of other work, and program balance. A DoD Component may elect to fund several or none of the proposed approaches to the same topic. In the evaluation and handling of proposals, every effort will be made to protect the confidentiality of the proposal and any evaluations. There is no commitment by the DoD Components to make any awards on any topic, to make a specific number of awards or to be responsible for any monies expended by the proposer before award of a contract.

For proposals that have been selected for contract award, a Government Contracting Officer will draw up an appropriate contract to be signed by both parties before work begins. Any negotiations that may be necessary will be conducted between the offeror and the Government Contracting Officer. It should be noted that only a duly appointed contracting officer has the authority to enter into a contract on behalf of the U.S. Government.

Phase II proposals will be subject to a technical review process similar to Phase I. Final decisions will be made by DoD Components based upon the scientific and technical evaluations and other factors, including a commitment for Phase III follow-on funding, the possible duplication with other research or research and development, program balance, budget limitations, and the potential of a successful Phase II effort leading to a product of continuing interest to DoD.

Upon written request and after final award decisions have been announced, a debriefing will be provided to unsuccessful offerors on their proposals.

4.2 Evaluation Criteria - Phase I

The DoD Components plan to select for award those proposals offering the best value to the government with approximately equal consideration given to each of the following criteria, except for item a., which will receive twice the weight of any other item.

a. Scientific/technical quality of the Phase I research or research and development proposal and its relevance to the topic description, with special emphasis on its innovation and originality.
b. Qualifications of the principal investigator, other key staff, and consultants, if any, and the adequacy of available or obtainable instrumentation and facilities.
c. Anticipated benefits of the research or research and development to the total DoD research and development effort.
d. Adequacy of the Phase I proposed effort to show progress toward demonstrating the feasibility of the concept.

Where technical evaluations are essentially equal in merit, cost to the government will be considered in determining the successful offeror.

Technical reviewers will base their conclusions only on information contained in the proposal. It cannot be assumed that reviewers are acquainted with the firm or key individuals or any referenced experiments. Relevant supporting data such as journal articles, literature,

including government publications, etc., should be contained or referenced in the proposal.

4.3 Evaluation Criteria - Phase II

The Phase II proposal will be reviewed for overall merit based upon the criteria below.

a. Anticipated benefits of the research or development to the total DoD research and development effort.
b. Scientific/technical quality of the proposal, with special emphasis on its innovation and originality.
c. Qualifications of the principal investigator and other key personnel to carry out the proposed work.
d. Degree to which the Phase I objectives were met at the time of Phase II proposal submission.
e. Adequacy of the Phase II objectives to meet the opportunity or solve the problem.

The reasonableness of the proposed costs of the effort to be performed will be examined to determine those proposals that offer the best value to the government. Where technical evaluations are essentially equal in merit, cost to the government will be considered in determining the successful offeror.

In the case of proposals of approximately equal merit, the provision of a follow-on Phase III funding commitment for continued development from non-federal funding sources will be given special consideration. The follow-on funding commitment must provide that a specific amount of Phase III funds will be made available to or by the small business and indicate the dates the funds will be made available. It must also contain specific technical objectives which, if achieved in Phase II, will make the commitment exercisable by the small business. The terms cannot be contingent upon the obtaining of a patent due to the length of time this process requires. The funding commitment shall be submitted with the Phase II proposal.

Phase II proposal evaluation may include on-site evaluations of the Phase I effort by government personnel.

5.0 CONTRACTUAL CONSIDERATIONS

Note: Eligibility and Limitation Requirements (Section 1.4) Will Be Enforced

5.1 Awards (Phase I)

a. Number of Phase I Awards. The number of Phase I awards will be consistent with the agency's RDT&E budget, the number of anticipated awards for interim Phase I modifications, and the number of anticipated Phase II contracts. No Phase I contracts will be awarded until all qualified proposals (received in accordance with Section 6.2) on a specific topic have been evaluated. All proposers will be notified of selection/non-selection status for a Phase I award no later than July 15, 1993. The name of those firms selected for awards will be announced. *The DoD Components anticipate making 1300 Phase I awards during Fiscal Year 1993.*

b. Type of Funding Agreement. All winning proposals will be funded under negotiated contracts and may include a fee or profit. The firm fixed price or cost plus fixed fee type contract will be used for all Phase I projects (see Section 5.4). *Note: The firm fixed price contract is the preferred type for Phase I.*

c. Average Dollar Value of Awards. DoD Components will make Phase I awards to small businesses typically on a one-half person-year effort over a period generally not to exceed six months (subject to negotiation). The legislative history of PL 97-219 and PL 99-443 clearly envisioned a large number of Phase I awards up to $50,000 each (adjusted for inflation).

5.2 Awards (Phase II)

a. Number of Phase II Awards. The number of Phase II awards will depend upon the results of the Phase I efforts and the availability of funds. *The DoD Components anticipate making 400 Phase II awards during Fiscal Year 1993.*

b. Type of Funding Agreement. Each Phase II proposal selected for award will be funded under a negotiated contract and may include a fee or profit.

c. Project Continuity. Phase II proposers who wish to maintain project continuity must submit proposals no later than 30 days prior to the expiration date of the Phase I contract and must identify in their proposal the work to be performed for the first four months of the Phase II effort and the costs associated therewith. *These Phase II proposers may be issued a modification to the Phase I contract, at the discretion of the government*, covering an interim period not to exceed four months for preliminary Phase II work while the total Phase II proposal is being evaluated and a contract is negotiated. This modification would normally become effective at the completion of Phase I or as soon thereafter as possible. Funding, scope of work, and length of performance for this interim period will be subject to negotiations. Issuance of a contract modification for the interim period does not commit the government to award a Phase II contract.

d. Average Dollar Value of Awards. Phase II awards will be made to small businesses based on results of the Phase I efforts and the scientific and technical merit of the Phase II proposal. Average Phase II awards will typically cover 2 to 5 person-years of effort over a period generally not to exceed 24 months (subject to negotiation). The legislative history of PL 97-219 and PL 99-443 clearly envisioned that the Phase II awards would be up to $500,000 each (adjusted for inflation).

5.3 Reports

a. Content. A final report is required for each Phase I project. The report must contain in detail the project objectives, work performed, results obtained, and estimates of technical feasibility. A completed SF 298, "Report Documentation Page", will be used as the first page of the report. (A Sample SF 298 is provided in Reference D.)

b. Preparation.

(1) To avoid duplication of effort, language used to report Phase I progress in a Phase II proposal, if submitted, may be used verbatim in the final report with changes to accommodate results after Phase II proposal submission and modifications required to integrate the final report into a self-contained comprehensive and logically structured document.

(2) Block 12a (Distribution/Availability Statement) of the SF298, "Report Documentation Page" in each unclassified final report must contain one of the following statements:
   (a) Distribution authorized to U.S. Government Agencies only; report contains proprietary data produced under SBIR contract. Other requests shall be referred to the performing organization in Block 7 of this form.
   (b) Approved for public release; SBIR report, distribution unlimited.

(3) The report abstract (Block 13 of the SF 298, "Report Documentation Page") must identify the purpose of the work and briefly describe the work carried out, the finding or results and the potential applications of the effort. Since the abstract may be published by the DoD, it must not contain any proprietary or classified data.

c. Submission. SIX COPIES of the final report on each Phase I project shall be submitted within the DoD in accordance with the negotiated delivery schedule. Delivery will normally be within thirty days after completion of the Phase I technical effort. One copy of each unclassified report shall be delivered directly to the DTIC, ATTN: Document Acquisition, Cameron Station, Alexandria, VA 22304-6145.

5.4 Payment Schedule

The specific payment schedule (including payment amounts) for each contract will be incorporated into the contract upon completion of negotiations between the DoD and the successful Phase I offeror. Successful offerors may be paid periodically as work progresses in accordance with the negotiated price and payment schedule. Phase I contracts are primarily fixed price contracts, under which monthly progress payments may be made up to 85% of the contract price excluding fee or profit. The contract may include a separate provision for payment of a fee or profit. Final payment will follow completion of contract performance and acceptance of all work required under the contract. Other types of financial assistance may be available under the contract.

5.5 Markings of Proprietary or Classified Proposal Information

The proposal submitted in response to this solicitation may contain technical and other data which the proposer does not want disclosed to the public or used by the government for any purpose other than proposal evaluation.

Information contained in unsuccessful proposals will remain the property of the proposer except for Appendices A and B. The government may, however, retain copies of all proposals. Public release of information in any proposal submitted will be subject to existing statutory and regulatory requirements.

If proprietary information is provided by a proposer in a proposal which constitutes a trade secret, proprietary commercial or financial information, confidential personal information or data affecting the national security, it will be treated in confidence, to the extent permitted by law, provided this information is clearly marked by the proposer with the term "confidential proprietary information" and provided that the following legend which appears on the title page (Appendix A) of the proposal is completed:

> "For any purpose other than to evaluate the proposal, this data except Appendix A and B shall not be disclosed outside the government and shall not be duplicated, used, or disclosed in whole or in part, provided that if a contract is awarded to the proposer as a result of or in connection with the submission of this data, the government shall have the right to duplicate, use or disclose the data to the extent provided in the contract. This restriction does not limit the government's right to use information contained in the data if it is obtained from another source without restriction. The data subject to this restriction is contained in page(s)_____of this proposal."

Any other legend may be unacceptable to the

government and may constitute grounds for removing the proposal from further consideration and without assuming any liability for inadvertent disclosure. The government will limit dissemination of properly marked information to within official channels.

In addition, each page of the proposal containing proprietary data which the proposer wishes to restrict must be marked with the following legend:

> "Use or disclosure of the proposal data on lines specifically identified by asterisk (*) are subject to the restriction on the cover page of this proposal."

The government assumes no liability for disclosure or use of unmarked data and may use or disclose such data for any purpose.

In the event properly marked data contained in a proposal in response to this solicitation is requested pursuant to the Freedom of Information Act, 5 USC 552, the proposer will be advised of such request and prior to such release of information will be requested to expeditiously submit to the DoD Component a detailed listing of all information in the proposal which the proposer believes to be exempt from disclosure under the Act. Such action and cooperation on the part of the proposer will ensure that any information released by the DoD Component pursuant to the Act is properly determined.

Those proposers that have a classified facility clearance may submit classified material with their proposal. Any classified material shall be marked and handled in accordance with applicable regulations. Arbitrary and unwarranted use of this restriction is discouraged. Offerors must follow the Industrial Security Manual for Safeguarding Classified Information (DoD 5220.22M) procedures for marking and handling classified material.

5.6 Copyrights

To the extent permitted by statute, the awardee may copyright (consistent with appropriate national security considerations, if any) material developed with DoD support. DoD receives a royalty-free license for the Federal Government and requires that each publication contain an appropriate acknowledgement and disclaimer statement.

5.7 Patents

Small business firms normally may retain the principal worldwide patent rights to any invention developed with government support. The government receives a royalty-free license for its use, reserves the right to require the patent holder to license others in certain limited circumstances, and requires that anyone exclusively licensed to sell the invention in the United States must normally manufacture it domestically. To the extent authorized by 35 USC 205, the government will not make public any information disclosing a government-supported invention for a reasonable time period to allow the awardee to pursue a patent.

5.8 Technical Data Rights

Rights in technical data, including software, developed under the terms of any contract resulting from proposals submitted in response to this solicitation shall remain with the contractor, except that the government shall have the limited right to use such data for government purposes and shall not release such data outside the government without permission of the contractor for a period of two years from completion of the project from which the data was generated unless the data has already been released to the general public. However, effective at the conclusion of the two-year period, the government shall retain a royalty-free license for government use of any technical data delivered under an SBIR contract whether patented or not.

5.9 Cost Sharing

Cost sharing is permitted for proposals under this solicitation; however, cost sharing is not required nor will it be an evaluation factor in the consideration of a proposal.

5.10 Joint Ventures or Limited Partnerships

Joint ventures and limited partnerships are eligible provided the entity created qualifies as a small business as defined in Section 2.2 of this solicitation.

5.11 Research and Analytical Work

a. For Phase I a minimum of two-thirds of the research and/or analytical effort must be performed by the proposing firm unless otherwise approved in writing by the contracting officer.

b. For Phase II a minimum of one-half of the research and/or analytical effort must be performed by the proposing firm.

5.12 Contractor Commitments

Upon award of a contract, the contractor will be required to make certain legal commitments through acceptance of government contract clauses in the Phase I contract. The outline that follows is illustrative of the types of provisions required by the Federal Acquisition Regulations that will be included in the Phase I contract. This is not a complete list of provisions to be included in Phase I contracts, nor does it contain specific wording of

these clauses. Copies of complete general provisions will be made available prior to award.

a. Standards of Work. Work performed under the contract must conform to high professional standards.

b. Inspection. Work performed under the contract is subject to government inspection and evaluation at all reasonable times.

c. Examination of Records. The Comptroller General (or a fully authorized representative) shall have the right to examine any directly pertinent records of the contractor involving transactions related to this contract.

d. Default. The government may terminate the contract if the contractor fails to perform the work contracted.

e. Termination for Convenience. The contract may be terminated at any time by the government if it deems termination to be in its best interest, in which case the contractor will be compensated for work performed and for reasonable termination costs.

f. Disputes. Any dispute concerning the contract which cannot be resolved by agreement shall be decided by the contracting officer with right of appeal.

g. Contract Work Hours. The contractor may not require an employee to work more than eight hours a day or forty hours a week unless the employee is compensated accordingly (that is, receives overtime pay).

h. Equal Opportunity. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.

i. Affirmative Action for Veterans. The contractor will not discriminate against any employee or applicant for employment because he or she is a disabled veteran or veteran of the Vietnam era.

j. Affirmative Action for Handicapped. The contractor will not discriminate against any employee or applicant for employment because he or she is physically or mentally handicapped.

k. Officials Not to Benefit. No member of or delegate to Congress shall benefit from the contract.

l. Covenant Against Contingent Fees. No person or agency has been employed to solicit or secure the contract upon an understanding for compensation except bonafide employees or commercial agencies maintained by the contractor for the purpose of securing business.

m. Gratuities. The contract may be terminated by the government if any gratuities have been offered to any representative of the government to secure the contract.

n. Patent Infringement. The contractor shall report each notice or claim of patent infringement based on the performance of the contract.

o. Military Security Requirements. The contractor shall safeguard any classified information associated with the contracted work in accordance with applicable regulations.

5.13 Additional Information

a. General. This Program Solicitation is intended for information purposes and reflects current planning. If there is any inconsistency between the information contained herein and the terms of any resulting SBIR contract, the terms of the contract are controlling.

b. Small Business Data. Before award of an SBIR contract, the government may request the proposer to submit certain organizational, management, personnel, and financial information to confirm responsibility of the proposer.

c. Proposal Preparation Costs. The government is not responsible for any monies expended by the proposer before award of any contract.

d. Government Obligations. This Program Solicitation is not an offer by the government and does not obligate the government to make any specific number of awards. Also, awards under this program are contingent upon the availability of funds.

e. Unsolicited Proposals. The SBIR Program is not a substitute for existing unsolicited proposal mechanisms. Unsolicited proposals will not be accepted under the SBIR Program in either Phase I or Phase II.

f. Duplication of Work. If an award is made pursuant to a proposal submitted under this Program Solicitation, the contractor will be required to certify that he or she has not previously been, nor is currently being, paid for essentially equivalent work by an agency of the Federal Government.

g. Classified Proposals. If classified work is proposed or classified information is involved, the offeror to the solicitation must have, or obtain, security clearance in accordance with the Industrial Security Manual for Safeguarding Classified Information (DoD 5220.22M).

6.0 SUBMISSION OF PROPOSALS

An original plus (4) copies of each proposal or modification will be submitted, in a single package, as described below, unless otherwise stated by specific instructions in Section 8.0.

NOTE: THE ORIGINAL OF EACH PROPOSAL MUST CONTAIN A COMPLETED RED COPY OF APPENDIX A (COVER SHEET) AND APPENDIX B (PROJECT SUMMARY).

6.1 Address

Each proposal or modification package must be addressed to that DoD Component address which is identified for the specific topic in that Component's section of Section 8.0 to this solicitation.

The name and address of the offeror, the solicitation number and the topic number for the proposal must be clearly marked on the face of the envelope or wrapper.

Mailed or handcarried proposals must be delivered to the address indicated for each topic. Secure packaging is mandatory. The DoD Component cannot be responsible for the processing of proposals damaged in transit.

All copies of a proposal must be sent in the same package. Do not send separate information copies or several packages containing parts of the single proposal.

6.2 Deadline of Proposals

Deadline for receipt of proposals at the DoD Component is 2:00 p.m. local time, January 15, 1993. Any proposal received at the office designated in the solicitation after the exact time specified for receipt will not be considered unless it is received before an award is made, and: (a) it was sent by registered or certified mail not later than January 8, 1993 or (b) it was sent by mail and it is determined by the government that the late receipt was due solely to mishandling by the government after receipt at the government installation.

Note: There are no other provisions for late receipt of proposals under this solicitation.

The only acceptable evidence to establish (a) the date of mailing of a late-received proposal sent either by registered mail or certified mail is the U. S. Postal Service postmark on the wrapper or on the original receipt from the U. S. Postal Service. If neither postmark shows a legible date, the proposal shall be deemed to have been mailed late. The term postmark means a printed, stamped, or otherwise placed impression (exclusive of a postage meter machine impression) that is readily identifiable without further action as having been supplied and affixed on the date of mailing by employees of the U. S. Postal Service. Therefore, offerors should request the postal clerk to place a hand cancellation bull's-eye postmark on both the receipt and the envelope or wrapper; (b) the time of receipt at the government installation is the time-date stamp of such installation on the proposal wrapper or other documentary evidence of receipt maintained by the installation.

Proposals may be withdrawn by written notice or a telegram received at any time prior to award. Proposals may also be withdrawn in person by an offeror or his authorized representative, provided his identity is made known and he signs a receipt for the proposal. (NOTE: the term telegram includes mailgrams.)

Any modification or withdrawal of a proposal is subject to the same conditions outlined above. Any modification may not make the proposal longer than 25 pages. Notwithstanding the above, a late modification of an otherwise successful proposal which makes its terms more favorable to the government will be considered at any time it is received and may be accepted.

6.3 Notification of Proposal Receipt

Proposers desiring notification of receipt of their proposal must complete and include a self-addressed stamped envelope and a copy of the notification form (Reference A) in the back of this brochure. If multiple proposals are submitted, a separate form and envelope is required for each. Notification of receipt of a proposal by the government does not by itself constitute a determination that the proposal was received on time or not. The determination of timeliness is solely governed by the criteria set forth in Section 6.2.

6.4 Information on Proposal Status

Evaluation of proposals and award of contracts will be expedited, but no information on proposal status will be available until the final selection is made. However, contracting officers may contact any and all qualified proposers prior to contract award.

6.5 Debriefing of Unsuccessful Offerors

Upon written request and after final award decisions have been announced, a debriefing will be provided to unsuccessful offerors for their proposals.

6.6 Correspondence Relating to Proposals

All correspondence relating to proposals should cite the SBIR solicitation number and specific topic number and should be addressed to the DoD Component whose address is associated with the specific topic number.

7.0 SCIENTIFIC AND TECHNICAL INFORMATION ASSISTANCE

7.1 DoD Technical Information Services Available

Recognizing that small business may not have strong technical information service support, the Defense Technical Information Center (DTIC) is prepared to give special attention to the needs of DoD SBIR Program participants.

DTIC is the central source of scientific and technical information resulting from and describing R&D projects that are funded by DoD. DTIC prepares a Technical Information Package (TIP) on each SBIR topic. The package includes information such as a reference list of related technical reports and expanded topic description from the topic author. DTIC searches this information for registered requesters. Reasonable quantities of paper or microfiche copies of requested documents are available for SBIR Program proposal preparation.

DTIC will also provide referrals to DoD-sponsored Information Analysis Centers (IACs), where specialists in mission areas assigned to these IACs perform informational and consultative services.

Many of the small business requesters who responded to previous DoD SBIR Program solicitations believe that the scientific and technical information which DTIC provided enabled them to make better informed bid/no bid decisions and prepare technically stronger proposals. People responding to this solicitation are encouraged to contact DTIC for bibliographies of technical reports that have resulted from prior DoD funded R&D, for copies of the technical reports which are cited in these bibliographies, and for information about DoD sponsored work currently in progress in their proposal topic areas.

DTIC assistance will include references to other sources of scientific and technical information needed to prepare SBIR Program proposals to DoD. Call or visit DTIC at the following location which is most convenient to you.

All written communications with DTIC must be made to the Cameron Station, Alexandria, VA, address.

Defense Technical Information Center
ATTN: DTIC-SBIR
Building 5, Cameron Station
Alexandria, VA 22304-6145
(800) 225-3842 (Toll Free)
(703) 274-6902 (Commercial)

DTIC Boston On-Line Service Facility
DTIC-BOS
Building 1103, Hanscom AFB
Bedford, MA 01731-5000
(617) 377-2413

DTIC Albuquerque Regional Office
AFWL/SUL Bldg. 419
Kirtland AFB, NM 87117-6008
(505) 846-6797

DTIC Los Angeles On-Line Service Facility
Defense Contract Administration Services Region
222 N. Sepulveda Blvd.
El Segundo, CA 90245-4320
(213) 335-4170

DTIC Matris Office
ATTN: DTIC-AM, Sally Ames
San Diego, CA 92152-6800
(619) 553-7008

Use Reference B at the back of this solicitation or telephone DTIC to request background bibliographies and descriptions of work in progress related to those topic areas which you plan to pursue under this solicitation. DTIC will return the material you request, annotated with a temporary User Code. This User Code is to be used by you when requesting additional information or when ordering documents cited in a bibliography until the solicitation closing date.

Because solicitation response time is limited, submit your requests for DTIC's information services as soon as possible. To assure the fastest possible mail service, give DTIC your Federal Express Account Number to which mailing charges will be made for overnight delivery.

7.2 Other Technical Information Assistance Sources

Other sources provide technology search and/or document services and can be contacted directly for service and cost information. These include:

National Technical Information Services
5285 Port Royal Road
Springfield, VA 22161
(703) 487-4600

University of Southern California
3715 South Hope Street, Suite 200
Los Angeles, CA 90007-4344
(213) 743-6132

Midcontinent Technology Transfer Center
Texas Engineering Experiment Station
The Texas A&M University System
237 Wisenbaker Engineering Research Center
College Station, TX 77843-3401
(409) 845-8762

Great Lakes Technology Transfer Center/Battelle
25000 Great Northern Corporate Center, Suite 450
Cleveland, OH 44070
(216) 734-0094

Center for Technology Commercialization
Massachusetts Technology Park
100 North Drive
Westborough, MA 01581
(508) 870-0042

Mid-Atlantic Technology Applications Center
University of Pittsburgh
823 William Pitt Union
Pittsburg, PA 15260
(412) 648-7000

Southern Technology Application Center
University of Florida, College of Engineering
Box 24, One Progress Boulevard
Alachua, FL 32615
(904) 462-3913 (local)
(800) 225-0308 (national)

Information Strategists
814 Elm Street
Manchester, NH 03101
(603) 624-8208

7.3 DoD Counseling Assistance Available

Small business firms interested in participating in the SBIR Program may seek general administrative guidance from small and disadvantaged business utilization specialists located in various Defense Contract Management activities throughout the continental United States. These specialists are available to discuss general administrative requirements to facilitate the submission of proposals and ease the entry of the small high technology business into the Department of Defense marketplace. The small and disadvantaged business utilization specialists are expressly prohibited from taking any action which would give an offeror an unfair advantage over others, such as discussing or explaining the technical requirements of the solicitation, writing or discussing technical or cost proposals, estimating cost or any other actions which are the offerors responsibility as outlined in this solicitation. (See Reference C at the end of this solicitation for a complete listing, with telephone numbers, of Small and Disadvantaged Business Utilization Specialists assigned to these activities.)

7.4 State Assistance Available

Many states have established programs to provide services to those small firms and individuals wishing to participate in the Federal SBIR Program. These services vary from state to state, but may include:

- Information and technical assistance;
- Matching funds to SBIR receipients;
- Assistance in obtaining Phase III funding.

Contact your State Government Office of Economic Development for further information.

8.0 TECHNICAL TOPICS

Section 8 contains detailed topic descriptions outlining the technical problems for which DoD Components requests proposals for innovative R&D solutions from small businesses. Topics for each participating DoD Component are listed and numbered separately. Each DoD Component Topic Section contains topic descriptions, addresses of organizations to which proposals are to be submitted, and special instructions for preparing and submitting proposals to organizations within the component. Read and follow these instructions carefully to help avoid administrative rejection of your proposal.

Appendices A, B and C follow the Component Topic Sections. Appendix A is a red-printed Proposal Cover Sheet, Appendix B is a red-printed Project Summary form, and Appendix C is an outline for the Cost Proposal. An original red-printed copy of Appendix A and Appendix B must be included with each proposal submitted.

U.S. ARMY 93.1

Submission of Proposals

This group of topics was originally prepared for the 92.2 SBIR publication last May. Unfortunately, there was a need to refocus the language, to better delineate what the topic author meant. We think these edited offerings describe more clearly what is required. We have also included the potential commercial market for several of the topic descriptions. Remember to contact DTIC (800) 225-3842 for additional information on these topics such as bibliographies, technical reports and information about DoD sponsored work currently in progress in the topic area. There is no direct communication possible with the topic author by law. You are welcome to call my office or the POC at the activity sponsoring the topic.

We plan to offer interim funding between Phase I and Phase II as in Solicitation 92.2. Specific instructions for the preparation of Phase II proposals will be sent to Phase I awardees by the responsible Army contracting offices at the time of award. Those Phase II applicants who wish to maintain project continuity must submit their completed proposals no later than 45 days prior to the expiration of the Phase I contract. Successful Phase II applicants may then be issued a contract modification covering a four-month interim period of performance while the Phase II contract is being negotiated. This modification can be expected to become effective at the completion of the Phase I contract, or as soon thereafter as possible. Funding for this interim period is intended to cover the start-up costs of the Phase II effort, and will not exceed a proration of the total Phase II effort as determined by the Army SBIR Program Manager.

J. Patrick Forry
Army SBIR Program Manager

Commander
U.S. Army Laboratory Command
ATTN: AMSLC-TP-TS (Mr. J. Forry)
2800 Powder Mill Road
Adelphi, MD 20783-1145
(301) 394-4602

ARMY SMALL BUSINESS INNOVATION RESEARCH PROGRAM

Submitting Proposals on Army Topics

Phase I proposal (5 copies including 1 red-printed form) should be addressed to:

Point of Contact

ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (ARDEC)
Topic Nos. A93-001 through A93-002 — J. Greenfield, (201) 724-6048

Commander
U.S. Army Armament RD&E Center
ATTN: SMCAR-ASC (SBIR Program)
Bldg. 1, (J. Greenfield)
Picatinny Arsenal, NJ 07806-5000

AVIATION SYSTEMS COMMAND (AVSCOM)
Topic Nos. A93-003 through A93-005 — R. Warhover, (314) 263-1074

Commander
U.S. Army Aviation Systems Command
ATTN: AMSAV-A-PDLZ (SBIR Program)
4300 Goodfellow Blvd., Bldg. 102
St. Louis, MO 63120-1798

BELVOIR RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (BRDEC)
Topic Nos. A93-006 through A93-007 — C. Jacobs, (703) 704-2253

Mail address:
Commander
U.S. Army Belvoir RD&E Center
ATTN: AMSTR-PBP (SBIR Program)
Bldg 314, Procurement Receptionist
Ft. Belvoir, VA 22060-5606

Handcarry address:
U.S. Army Belvoir RD&E Center
ATTN: STRBE-D (C. Jacobs)
Bldg. 312, Rm. 115
Ft. Belvoir, VA 22060-5606

COMMUNICATION ELECTRONICS COMMAND (CECOM)
Topic Nos. A93-008 through A93-010 — J. Crisci, (908) 544-2665

Commander
US Army Communications-Electronics Command
ATTN: AMSEL-AC-BID (SBIR Program)
CECOM Office Building
Wayside Road and Tinton Avenue (Intersection)
Fort Monmouth, NJ 07703-5099

CHEMICAL RESEARCH DEVELOPMENT AND ENGINEERING CENTER (CRDEC)

Topic Nos. A93-011 through A93-013

R. Hinkle
(410) 671-2031

Commander
U.S. Army Chemical Research, Development and Engineering Center
Procurement Directorate
ATTN: SMCCR-PCA (Mr. Baker)
Building 4455, SBIR Program
Edgewood Site
Aberdeen Proving Ground, MD 21010-5423

MISSILE COMMAND (MICOM)

Topic Nos. A93-014 through A93-019

O. Thomas, Jr.
(205) 842-9227

Commander
U.S. Army Missile Command
ATTN: AMSMI-RD-PC-HB, Mr. Frederick Glover, III (SBIR Program)
Redstone Arsenal, AL 35898-5275

TANK-AUTOMOTIVE COMMAND (TACOM)

Topic Nos. A93-020

A. Sandel
(313) 574-7545

Commander
U.S. Army Tank-Automotive Command
ATTN: AMSTA-IRSA (SBIR Program)
Bldg. 200A
Warren, MI 48397-5000

TEST AND EVALUATION COMMAND (TECOM)

R. Cozby
(410) 278-7883

Topic Nos. A93-021

Commander
U.S. Army Aberdeen Proving Ground Support Activity
Directorate of Contracting
ATTN: STEAP-PR-S, SBIR Program
Ryan Bldg., Room 124
Aberdeen Proving Ground, MD 21005-5001

SIMULATION, TRAINING, AND INSTRUMENTATION COMMAND (STRICOM)

Topic Nos. A93-022

A. Piper
(407) 380-4287

U.S. Army Simulation, Training, and Instrumentation Command
Attn: Code PP (Mr. J. Balbona)
12350 Research Parkway
Orlando, FL 32826

LABORATORY COMMAND

Army Research Office (ARO)

M. Brown
(919) 549-4336

Topic Nos. A93-023

Director
U.S. Army Research Office
ATTN: SLCRO-RT (ARO SBIR Program)
P.O. Box 12211
Research Triangle Park, NC 27709-2211

Ballistics Research Laboratory (BRL) — R. Dimmick
Topic Nos. A93-024 — (410) 278-6955

Director
U.S. Army Chemical Research, Development and Engineering Center
Procurement Directorate
ATTN: SMCCR-PCB (BRL SBIR Program)
Building 4455
Edgewood Site
Aberdeen Proving Ground, MD 21010-5423

Harry Diamond Laboratories (HDL) — D. Hudson
Topic Nos. A93-025 — (301) 394-4808

Director
U.S. Army Harry Diamond Laboratories (HDL)
ATTN: SLCHD-SD-P, D. Hudson (SBIR Program)
2800 Powder Mill Rd.
Adelphi, MD 20783-1197

Human Engineering Laboratories (HEL) — J. Sissum
Topic Nos. A93-026 through A93-027 — (410) 278-5815

Commander
U.S. Army Chemical Research, Development and Engineering Center
Procurement Directorate
ATTN: SMCCR-PCA, SBIR Program (HEL)
Edgewood Area, Bldg. E4455
Aberdeen Proving Ground, MD 21010-5423

Materials Technology Laboratory (MTL) — R. Morrissey
Topic Nos. A93-028 — (617) 923-5522

Director
U.S. Army Materials Technology Laboratory
ATTN: SLCMT-TMP (SBIR Program)
405 Arsenal Street
Bldg. 131, Rm 144
Watertown, MA 02172-2719

ARMY CORPS OF ENGINEERS

U.S. Army Construction Engineering Research Laboratory (CERL) — D. Moody
Topic Nos. A93-029 — (217) 373-7290

Commander
U.S. Army Construction Engineering Research Laboratories
ATTN: CECER-CT (SBIR Program)
Building 1
2902 Newmark Drive
Champaign, IL 61821-1076

U.S. Army Topographic Engineering Center (TEC) — C. McKenna
Topic Nos. A93-030 through A93-031 — (703) 355-2630

Commander
U.S. Army Topographic Engineering Center
ATTN: CETEC-ZC-A (SBIR/McKenna)
Building 2592, Telegraph and Leaf Roads
Ft. Belvoir, VA 22060-5546

ARMY MEDICAL RESEARCH ACQUISITION ACTIVITY (MEDICAL)

Topic Nos. A93-032 through A93-034

Commander
U.S. Army Medical Research Acquisition Activity
ATTN: SGRD-RMA-RC, SBIR Program
Ft. Detrick, Bldg. 820
Frederick, MD 21702-5014

A. Wolf
(301) 619-7216

STRATEGIC DEFENSE COMMAND (SDC)

Topic Nos. A93-035 through A93-036

Commander
U.S. Army Strategic Defense Command
ATTN: CSSD-H-CM-CB (SBIR Program)
P.O. Box 1500
106 Wynn Drive
Huntsville, AL 35807-3801

E. Roy
(205) 955-4393

ARMY SBIR PROGRAM
POINTS OF CONTACT SUMMARY

A93-001/A93-002	ARDEC	J. GREENFIELD	201-724-6048
A93-003/A93-005	AVSCOM	R. WARHOVER	314-263-1074
A93-006/A93-007	BRDEC	C. JACOBS	703-704-2253
A93-008/A93-010	CECOM	J. CRISCI	908-544-2665
A93-011/A93-013	CRDEC	R. HINKLE	410-671-2031
A93-014/A93-019	MICOM	O. THOMAS, JR.	205-842-9227
A93-020	TACOM	A. SANDEL	313-574-7545
A93-021	TECOM	R. COZBY	410-278-7883
A93-022	STRICOM	A. PIPER	407-380-4287
A93-023	ARO	M. BROWN	919-549-4336
A93-024	BRL	R. DIMMICK	410-278-6955
A93-025	HDL	D. HUDSON	301-394-4808
A93-026/A93-027	HEL	J. SISSUM	410-278-5815
A93-028	MTL	R. MORRISSEY	617-923-5522
A93-029	CERL	D. MOODY	217-373-7290
A93-030/A93-031	TEC	C. MCKENNA	703-355-2630
A93-032/A93-034	MEDICAL	A. WOLF	301-619-7216
A93-035/A93-036	SDC	E. ROY	205-955-4393

SUBJECT/WORD INDEX TO THE ARMY SBIR SOLICITATION

INDEX OF ARMY FY93 TOPICS

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A93-020 Real Time Integrity/Durability Monitoring of Composite Structures

TEST AND EVALUATION COMMAND (TECOM)

A93-021 Vehicle Magnetic Signature Image Enhancement

SIMULATION, TRAINING, AND INSTRUMENTATION COMMAND (STRICOM)

A93-022 Simulator/Simulation Based Intelligent Tutoring Systems (ITS)

ARMY RESEARCH OFFICE (ARO)

A93-023 High Dimensionality Decision Module

BALLISTICS RESEARCH LABORATORY (BRL)

A93-024 High Energy Diode Laser Ignition System

HARRY DIAMOND LABORATORY (HDL)

A93-025 Noise Filters

HUMAN ENGINEERING LABORATORY (HEL)

A93-026 Virtual Reality Environment as Control Interface for Unmanned Ground Vehicles (UGVs)

A93-027 Development of an Auditory Signal Processing System

MATERIALS TECHNOLOGY LABORATORY (MTL)

A93-028 Nondestructive Evaluation Method for Environmental Deterioration of Fiber-Reinforced Organic Matrix Composites

CONSTRUCTION ENGINEERING RESEARCH LABORATORY (CERL)

A93-029 Construction and Rehab Materials Made From Recycled Post-Consumer Wastes

TOPOGRAPHIC ENGINEERING CENTER (TEC)

A93-030 Texture Library for 3-Dimensional Visualization Systems

A93-031 Development of a Surface Microroughness Compilation

MEDICAL RESEARCH ACQUISITION ACTIVITY (MEDICAL)

A93-032	Neurotoxins
A93-033	A Transducer/Equipment System for Capturing Speech Information for Subsequent Processing by Computer Systems
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A93-035	Performance Upgrade Kit for AN/MPS-36 Radars
A93-036	Transmitter Upgrade Kit for AN/FPQ-19 Radars

DEPARTMENT OF THE ARMY

FY 1993 TOPIC DESCRIPTIONS

ARMAMENTS RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (ARDEC)

TOPIC: A93-001 TITLE: Smart Mortar Guidance

CATEGORY: Exploratory Development

OBJECTIVE: Develop and Demonstrate Smart Mortar Munitions

DESCRIPTION: The goal of this effort would be to develop smart mortar munitions employing on-board guidance to improve accuracy and to effectively engage armor and other hard targets. Fiber optic guidance, laser designation and autonomous guidance technologies and some of the suggested approaches to providing solutions and achieve performance objectives.

Phase I: Develop mortar design methodology and formulate concepts for munition guidance sub-systems. Develop functional specifications for individual system components. Develop plans for Phase II.

Phase II: Develop laboratory prototypes and conduct tests to evaluate ability to provide surgical kill capability. Develop performance models to evaluate overall effectiveness. Develop marketing plans for both military product lines and technology spin-offs to commercial product lines.

Potential Commercial Market: The contractor is expected to successfully market products developed under Phase I and II for military supplications. As this effort part of the new DoD S&T Thrust #5, Advanced Land Combat, there is high potential or Phase III for the military market. There is some potential for foreign military sales as well as to DoD. If autonomous guidance is the principal technology there will be commercial applications in the areas of automation and robotics.

TOPIC: A93-002 TITLE: Sub-Munitions with Identification Friend or Foe Capability

CATEGORY: Exploratory Development

OBJECTIVE: Develop and demonstrate advanced sub-munitions with a positive capability to identify friend or foe (IFF) to be launched by artillery, missiles (MLRS-variant) and helicopter rockets (Hellfire).

DESCRIPTION: Future weapon systems need a means of identifying friend or foe to reduce or eliminate hitting friendly forces and to increase the effectiveness (i.e. probability of kill) on the future battlefield. Advances in sensor technologies and the fusion of multiple sensor show potential to achieve this objective. This effort would demonstrate the feasibility of these technologies by devising innovative methods to acquire and identify targets while rejecting false target signatures.

Phase I: Program would develop system requirements and preliminary design concepts and a plan for development.

Phase II: Evaluate design concepts using wargame models and fabricate hardware for laboratory tests. Feasibility demonstration of munition and IFF capability will be via simulation and field tests. Develop marketing plans for both military product lines and technology spin-offs to commercial product lines.

Potential Commercial Market: The Phase II potential should be high for the military market as this effort would be a part of the DoD S&T Thrust #5 Advanced Land Combat. There is some potential for foreign military sales. Applications in the commercial include subsystems to aid in identification, security and automated manufacturing.

AVIATION SYSTEMS COMMAND (AVSCOM)

TOPIC: A93-003 TITLE: Ballistic Protection for Critical Aircraft Wiring

CATEGORY: Exploratory Development

OBJECTIVE: To define and test concepts that will improve the survivability of flight critical aircraft wiring to high explosive incendiary (HEI) ballistic threats.

DESCRIPTION: Future Army aircraft will incorporate increased amounts of wiring due to more mission equipment, more aircraft survivability equipment and the introduction of fly-by-wire and fly-by-light flight control systems. Wiring systems are inherently vulnerable to HEI threats, even though survivability measures such as redundancy,masking, and separation are utilized.

Phase I: Generic ballistic protection concepts shall be defined using advanced composite materials and/or ceramics, if appropriate. Emphasis shall be placed on light weight, low cost, ease of filed installation,low flammability and chemical resistance. The concepts shall completely encase the wiring and include provisions for integration with current mounting hardware. conduct tradeoff analyses and recommend the three most promising concepts.

Phase II: Fabricate the three Phase I concepts and the Government will conduct 23 mm HEI ballistic tests to determine their ability to protect wires form damage. Conduct simple chemical test to determine each concepts capability to resistance damage by typical aviation fluids (e.g., hydraulic, JP-4, JP-5). Simple flammability tests shall be conducted to determine each concepts resistance to heat and flame without producing toxic gases.

TOPIC: A93-004 TITLE: Modeling Complex Automatic Flight Controls for Helicopter Systems

CATEGORY: Exploratory Development

OBJECTIVE: Development and integration of advanced flight control modeling capabilities into comprehensive helicopter model.

DESCRIPTION: Current and future helicopters under development by the Army will rely heavily on advanced, high bandwidth, digital flight control systems to significantly enhance the mission capabilities of the aircraft. Advanced flight control synthesis techniques are being coupled with increasingly sophisticated comprehensive analytical models of helicopter structural dynamics and fluid mechanics in order to design more effective flight control systems. The Army is currently developing a Second Generation Comprehensive Helicopter Analysis System (2GCHAS) to provide significant improvements in helicopter analysis capability but it is currently restricted to simplified flight control system models.

Aircraft control and stability augmentation systems are typically depicted as block diagrams. These diagrams are representations which relate the inputs to the outputs in terms of linear, non-linear, and boolean operations. Although 2GCHAS currently has a transfer function element, it is incapable of representing complex controls systems such as that of the UH-60 Blackhawk or the AH-64 Apache. In order to model realistic aircraft control systems, engine models, hydro-mechanical units, electrical control units, and fuel control systems, only a few basic control system block diagram elements are required. The set of basic elements consists of summing junctions, product junctions,gains, table look ups, transfer functions, limiters, hysteresis, deadbands, delays, and non-linear functions such as the trig functions. Using a general multi-input/multi-output approach with this set of control elements would provide a more robust modeling system and include all the effects that the user community requires.Any approach for adding this type of capability must address the user interface as well.

Phase I: Develop a specification and conceptual design for an advanced control system model for 2GCHAS, compatible with current 2GCHAS system architecture.

Phase II: Implement an advanced flight control modeling capability for 2GCHAS using structured design methodology including software, design documents, and appropriate user manual documentation.

TOPIC: A93-005 TITLE: Low-Cost Turbo Machinery Models for Aerodynamic Testing

CATEGORY: Exploratory Development

OBJECTIVE: Develop a method of fabricating a turbo machinery test article such as a small turbine rotor that would be suitable for cold-air testing and be significantly lower in cost than a conventionally-produced metal rotor.

DESCRIPTION: In order to simplify rig design requirements and instrumentation of turbo machinery test articles, overall aerodynamic performance testing is often performed at equivalent conditions rather than actual engine conditions. Such test

articles still are made by metal casting or machining methods. Stereo lithography is currently being used for rapid prototyping and for providing mold in casting processes thereby shortening development time. The objective of the effort would be to explore the potential for extending that technology to fabricating rotor models suitable for aerodynamic test at equivalent conditions.

Phase I: Evaluate potential of current stereo lithography methods to produce a rotor model suitable for use in an equivalent-air test environment. Factors to be considered are cost; surface finish;dimensional accuracy and control; machinability; and structural integrity. Explore innovative ideas for improving current methods or overcoming limitations. Recommend a candidate approach to be pursued in Phase II.

Phase II: Demonstrate the approach from Phase I by applying it to several existing small turbine rotor designs ranging from axial to radial configurations. Fabricate stereo lithographic models and demonstrate structural integrity capability in a rotating test at equivalent conditions.

BELVOIR RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (BRDEC)

TOPIC: A93-006 TITLE: Coating Design and Evaluation Model

CATEGORY: Basic Research

OBJECTIVE: To develop a computer model for design and evaluation of multispectral coatings.

DESCRIPTION: A computer model is desired that will aid in the Army's development of coatings for countersurveillance purposes. The model should consider diffuse and spectral reflectance including bidirectional reflectance distribution function, grazing angle reflectance, wavelength dependency of reflectance properties from ultraviolet through far infrared wavelengths, and material properties of coating constituents. Model parameters are to include physical and chemical properties of coating constituents. The model must be able to run on a Microvax II (VMS), Silicon Graphics (UNIX) and/or AT compatible personal computer.

Phase I: objective is to define model parameters and algorithms and to determine feasibility of approach.

Phase II: Is to implement algorithms, demonstrate ability of model to run on stated hardware, and to debug model. Phase III is to validate the model.

Potential Commercial Market: This research could possible impact the Paint Manufacturing Industry.

TOPIC: A93-007 TITLE: Accelerated Reliability Test Methodology for Environmental Control Systems

CATEGORY: Basic Research

OBJECTIVE: To develop methodologies for reliability testing of environmental control equipment which will accelerate the life characteristics of the equipment, thus reducing the amount of test time required to demonstrate a reliability value.

DESCRIPTION: Contractor will develop test methodologies, environments,and conversion factors for accelerated life testing of environmental control equipment. Current reliability test procedures will be reviewed and modified so as to accelerate the life characteristics of the equipment being tested, thus reducing test time. Conversion factors shall be developed between current test methodologies and the accelerated methodologies such that demonstrated reliability and confidence can be assessed from the accelerated test.

Phase I: The Phase I objective is to develop test methodologies,environment and conversion factors for accelerated life testing of environmental control equipment.

Phase II: Phase II is to utilize experience and lessons learned during Phase I to develop accelerated test methodologies and conversion factor for power generation equipment.

Potential Commercial Market: This research should result in reliability testing specifications for air conditioners and heaters.This could reduce the amount of time required by Industry to demonstrate reliability

COMMUNICATIONS ELECTRONICS COMMAND (CECOM)

TOPIC: A93-008 TITLE: Cooperative Infrared Jamming Techniques

CATEGORY: Exploratory Development

OBJECTIVE: To develop techniques for using directional Infrared (IR) jammers and expendables cooperatively to defeat advanced IR guided missiles.

DESCRIPTION: Advanced IR missiles have been developed with the ability of resisting the effects of on-board and off-board jamming devices.Many missile systems are equipped with flare reject circuitry, and the Jamming to Signal Ratio (J/S) required using on-board jammers is very high to be effective. Techniques need to be developed that can use directional Infrared countermeasures (IRCM) devices and expendables cooperatively to enhance the overall effectiveness of the IRCM suite.Multiple launch and integration requirements with a missile warning receiver must also be considered in this evaluation.

Phase I: Evaluate IR missile technology, directable IR jammers and expendables. Determine the shortcomings of on and off-board jamming and the susceptibility of missiles to various jamming techniques.Formulate ideas of how jammers and expendables can work cooperatively.Determine time lines for these cooperative techniques.

Phase II: Develop algorithms and run computer simulations that can evaluate the effectiveness of various cooperative jamming techniques developed in Phase I. Determine the most effective techniques vs. various missile types and multiple launch scenarios. Develop a test plan for a possible Phase III live firing that would demonstrate the concept of cooperative jamming.

Potential Commercial Market: Perform a live firing to determine the effectiveness of cooperative jamming. Select various flare types and non-coherent jamming sources that can be used for a field test.Coordinate all test personnel involved in the live firing and conduct meetings to finalize the test plan and address all issues and requirements. Develop a schedule of events to meet program goals.Once testing is complete, evaluate test results and determine a best approach for each type of missile as well as a generic approach. This type of demonstration can provide a method of defeating advanced IR missiles using conventional IRCM cooperatively with flares while more sophisticated coherent source approaches are being developed.

TOPIC: A93-009 TITLE: Requirements Engineering Technology Insertion

CATEGORY: Advanced Development

OBJECTIVE: Commercial availability of advanced requirements engineering technologies, techniques, and processes which have near term relevance and benefit to large scale Army software developments.

DESCRIPTION: Requirements Engineering addresses issues relating to the elicitation, validation, specification, tracing, and life cycle management of various user or system stakeholder requirements for large scale software intensive systems throughout their life cycles.This encompasses functional and non-functional requirements(constraints). The focus for this effort is relevant technology enhancement and insertion to reduce near-term requirements related risk(cost, schedule, and quality) during the acquisition, development,acceptance, and maintenance processes. This takes into account DoD language, development, and documentation standards as well as integration into commercially available software engineering environments. Proposed efforts must demonstrate near term relevance by including endorsement from DoD project management of a specific and ongoing large scale software development or maintenance. Endorsement must reflect project management's recognition of the significance of this support as well as the willingness to provide the offeror with needed access to program documentation, personnel, and facilities.

Phase I: Identify need, opportunities, and feasibility of:1)developing, enhancing, or integrating requirements engineering technology and 2)inserting this technology into a specific system under development or maintenance. Develop a detailed plan for implementation, insertion and for measurement of benefit. The intention is that the identified system will be used as a vehicle to first define the requirements of the technology effort. The system will then be used to measure and demonstrate the benefit of the technology being developed.

Phase II: Implement the Phase I plan. Constructing a prototype which demonstrates this new technology. Demonstrate its value by performing technology insertion to support the identified system. Measure and report upon benefit

of this new technology. While the technology will meet the needs of the identified system, it shall be developed to provide the ends of a broad class of systems.

Potential Commercial Market: Productive developed technology into commercially available off-the-shelf software, including user documentation, on-line help, end user support, and training courses.

TOPIC: A93-010 TITLE: Management and Reuse of Software Requirements

CATEGORY: Advanced Development

OBJECTIVE: Develop a method along with automated support tools for managing software requirements to encourage domain specific software use. The proposed techniques shall support the use of the DoD standard language, Ada. The domain of interest for the phase II prototype is Army Command and Control (C2).

DESCRIPTION: The current approach to the development of DoD software intensive systems manages requirements at the system level and below;with proper automated support, software requirements could also be managed at the domain level. Extending this approach, other software assets (architectures, designs, components, etc.) and their mapping to each system implementation could also be managed at the domain level.Using such an automated system, teams defining requirements for new or improved systems would benefit from the reuse of existing requirements. In addition, developers would also benefit having access to not only assets associated with the portion of their requirements that are "reused" but also to assets associated with"similar" requirements. IF the tool could be extended to manage requirements from multiple domains, requirements and associated assets could then be reused across domains.

The automated system, or tool, should be capable of providing sufficient information for a user to determine the degree to which existing assets could be reused. The users of such a tool will have different levels of understanding of the domain; their interface to the tool should be as simple and "user friendly" as possible. The goal of this effort is to promote cost savings for the DoD by encouraging reuse, increasing software reliability and developing more efficient methods for creating intensive systems.

Phase I: This is the concept validation phase. Alternative approaches shall be investigated and if possible, a phase I demonstration should be included to illustrate how the proposed tools will automate the process. The potential CECOM user (PEOs, PMs and system developers)shall be identified during phase I. Proposals with CECOM user endorsements will be given special consideration. The only required deliverable in phase I is a final report documenting the results of the investigations and analyses and describing the selected approach in detail along with a means for estimating or measuring the merits.

Phase II: This is the prototyping phase. The approach will be refined and a prototype of the proposed automated support tool will be developed. A demonstration based on a CECOM C2 system shall be conducted to verify the method. Candidates for the demonstration shall be identified in the proposal. The prototype tool shall be delivered to the government along with a draft specification of the commercial version. Manuals to document the process and a user's guide should accompany the prototype tool set.

Potential Commercial Market: This is the commercialization phase.The developer is expected to finance this effort with non-government resources. CECOM Software Engineering Directorate may be interested in becoming a beta test site to provide government/user feedback into the commercial product.

CHEMICAL RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (CRDEC)

TOPIC: A93-011 TITLE: The Identification of A Non-Proprietary Mildew Inhibitor System for Particulate Filtration Media

CATEGORY: Exploratory Development

OBJECTIVE: The identification of a non-proprietary mildew inhibition system for the cellulose based filtration media of the 200 CFM Collective Protection Particulate Filter. Such an inhibitor must not degrade the effectiveness of the filter media and must not pose any health hazards to the users of the item.

DESCRIPTION: General - This effort would be to identify anon-proprietary mildew inhibition system for a filtration media conforming to the currently specified performance parameters. There is some randomness in the abilities of the current recommended sources to meet the imposed mildew resistance requirements.

Phase I: The desired result of a Phase I effort would be the identity of an appropriate milder inhibitor with supportive test data. The test procedures/parameters as described in the current edition of MIL-STD-810 would govern such exploratory efforts.

Phase II: An expansion of the phase I effort with more verification testing.

Potential Commercial Market: A mildew inhibiter would also have application to commercial particulate filters used for air pollution control and environmental hygiene.

TOPIC: A93-012 TITLE: Portable Biological Aerosol Sampler

CATEGORY: Exploratory Development

OBJECTIVE: To develop a high volume, stand alone biological sampler that is capable of interfacing with existing biological agent detection technology.

DESCRIPTION: The Army has an ongoing requirement for a means of rapid detection of potentially pathogenic and toxic analytes in the field.This capability is essential to field commanders for determining an adequate level of protection of personnel. Current bio-sampling/detection technology is heavy, expensive, and available in limited numbers. The proposed study would provide an extended and flexible collection capability of field air samples at a much lower per unit cost.

Phase I: This effort would explore the feasibility of developing technology or adapting existing commercial technology for a portable self-powered aerosol sampler. The sample would impinge on or into an appropriate sampling media, such as a buffer. The unit must interface with existing detection technologies. It would be able to collect samples from a variety of environments typically encountered in the field. Contractor would be encouraged to deliver a working breadboard unit at the completion of the Phase I effort.

Phase II: This effort would develop a prototype with emphasis on weight, size, power consumption, and sampling efficiency.

Potential Commercial Market: The biological sampler would be used in conjunction with a biological agent detector for the rapid field detection of pathogens or toxins. Such a detector would have both medical and environmental applications.

TOPIC: A93-013 TITLE: Development of AM1 Semi-empirical Parameters for the Group V and Group VI Elements

CATEGORY: Basic Research

OBJECTIVE: Develop AM1 semi-empirical parameters for selected elements for the Group III, V, and VI elements.

DESCRIPTION: The Neglect of Diatomic Differential Overlap (NDDO)semi-empirical molecular orbital approach has become extremely valuable in examining organic and organometallic compounds. The newest of these approaches, AM1, is finding wide-spread acceptance among many researchers from academia, industry and government. AM1 has been used very successfully to investigate properties of a large number of molecules. These results have proven valuable in predicting physical, chemical, and biological properties, and in understanding the behavior of chemical compounds. However, because this approach does rely on empirically derived parameters, many molecules containing unparameterized atoms cannot be investigated.

Phase I: Phase I of this research will begin with the retrieval of appropriate experimental data from the literature. The elements will be ordered in terms of priority. The highest priority elements for which sufficient experimental data exist will be parameterized during this phase.

Phase II: Phase II will continue the parameterization of the main group elements. The results for molecules containing elements parameterized during Phase I will be completely verified, and parameters will be developed for the remaining elements, in descending order of priority. All parameters will be included into the most recent versions of

AMPAC and MOPAC, and released to the public domain via appropriate mechanisms. In this way, this research will benefit not only government researchers, but those in academia and the private sector as well. The final product, a greatly enhanced version of the most popular semi-empirical molecular orbital programs, will greatly assist many researchers who currently cannot employ these programs.

MISSILE COMMAND (MICOM)

TOPIC: A93-014 TITLE: Integrated Three Color Sensor for Simultaneous Image Fusion

CATEGORY: Exploratory Development

OBJECTIVE: Design, Develop, and demonstrate the capability of fabricating a multispectral detector capable of simultaneous measurements of infrared radiation (0.7-12 microns) with high spatial resolution.

DESCRIPTION: The Optical Guidance Function of the Advanced Sensors Directorate is interested in the combination of co-bore sighted imagery simultaneously taken in three infrared bands (0.7 to 1.5) microns, 3 to 5 microns and 8 to 12 microns) to enhance the human detection of military target. The design of a single detector will create a common bore sight and simplify signal processing by eliminating the spatial and temporal registry of pixels associated with multiple sensors currently available.

Phase I: Identify, produce and characterize a single three color detector with the following pass bands: 0.7 to 1.5 microns, 3 to 5 microns, and 8 to 12 microns; develop architecture for simultaneous read out of each band. One or more of these goals should be addressed.

Phase II: Fabricate, test and demonstrate a full format detector array (64x64 or greater).

Potential Commercial Market: A sensor with three bands of infrared imagery, simultaneously fused and displayed, presents a unique capability of extending thermal and imaging signature analysis not currently available. Even though the sensor concept was specifically designed for military target acquisition and fire control systems, potential uses for the end product can benefit: jet engine analysis, environmental studies, law enforcement surveillance, or any application that incorporates broadband infrared radiometers.

TOPIC: A93-015 TITLE: Linear Microwave Attenuator

CATEGORY: Basic Research

OBJECTIVE: Precision modulation components for use in radar simulators.

DESCRIPTION: Commercially available microwave attenuators are designed and constructed to produce equal increments in decibels(log-power) for equal increments in control voltage or current. For many signal modulations applications, it is desirable to control signal levels linearly - i.e., equal increments in signal power for equal increments in control voltage or current. The specifications for this linear attenuator are the following:

Frequency Band:	1-2 GHz
Dynamic Range:	30 dB, min
Resolution:	0.1 % of maximum power
Control Bandwidth:	1 MHz, min
Incidental Phase Shift:	Less than 5 degrees over the band

Phase I: Design and build a prototype.

Phase II: Optimize, miniaturize, and build three devices for evaluation.

Potential Commercial Market: (1) Radar phased array antenna directivity control; (2) Modulation of radio frequency carrier frequencies by digital signals for digital commercial radio and television broadcasting and for digital communications; (3) electronic warfare products and simulators; (4) Radar signal simulators to test radar receiver and processor performance.

TOPIC: A93-016 TITLE: Teleoperation and Unmanned Systems/Robotic Enhancements

CATEGORY: Exploratory Development

OBJECTIVE: Improvements for teleoperation, controls and autonomous capabilities for unmanned systems.

DESCRIPTION: Incorporation of artificial intelligence and improved controls to improve remote operation and teleoperation of unmanned or optionally piloted vehicles. Smart sensors, navigation techniques,control theory or unique operations that will eventually lead to autonomous systems can be incorporated on test vehicles for evaluation. Techniques are needed to improve operator control functions, display configurations and improved communication capabilities between operator and remote units.

Phase I: Efforts proposed to improve system autonomy or increase capabilities to meet mission objectives of recon, intell, surveillance and target acquisition.

Phase II: Follow on efforts to push technology to acceptable performance levels in system autonomy or simultaneous cooperative performance from multiple vehicles.

Potential Commercial Market: Applications that are currently in use, and also in development, for commercial markets in the area of unmanned systems, and supporting technologies, are as follows: (1) Unmanned, remoted, and/or teleoperated systems for the removal, transporting and handling of hazardous materials, both toxic, and nuclear; (2) Enhancements with unmanned operations in hazardous situations, such as firefighting and law enforcement; (3) Construction efforts in heavy material handling, redundant tasks associated with excavation, transportation and loading; (4) Manufacturing applications for automating facilities, redundant assembly tasks, automated manufacturing cells, and the use of factory automated guided vehicles; (5) Space and underwater applications that are better performed remotely in the areas of repairs, maintenance, construction, and exploration.

TOPIC: A93-017 TITLE: A Multi-Node, Interactive, Task-Sharing, Expert-Instruction (MITE) Intelligent Tutoring System

CATEGORY: Basic Research

OBJECTIVE: This task objective is to develop and demonstrate a multi-node, interactive task-sharing, expanded (MITE) intelligent tutoring system (ITS). The MITE system will include three distributed nodes integrated for tutoring and training in a shared problem solving environment. The MITE system will be demonstrated with two integrated modes of operation; ITS mode, and TEAM mode. The ITS mode will provide full ITS operation for individual students. The TEAM mode has two options for shared problem solving; Full-Up Mode (FM) with students using the terminals, and a Pseudo-Student Mode (PM) with a student model replacing a human student at one of the three nodes.

DESCRIPTION: A modular architecture will be developed for the MITE system that integrates operation of ITS for individual tutoring, and training in a shared task problem solving environment. The ITS will be modular with replaceable code units identified for top level module, i.e., man-machine interface, diagnostic module, instructional module, and expertise module. The MITE system will be developed for networked personal computers (PC)(386 or better) with Windows 3.0 or equivalent memory extensions. The NASA CLIPS software will be used as a development environment.

The MITE operation in the ITS mode will evolve and mature a high fidelity student model that reflects the knowledge and skills of the student regarding the problem solving domain. The student model should evolve in size and complexity as the student's knowledge and skills increase. The student model contents must be capable of input/out from floppy disks. The ITS mode will allow the student to engage in any and all parts of the problems used in the team mode of operation.

The TEAM mode will allow students of varying levels of expertise to jointly engage in task sharing activities during a problem solving exercise. As the student's expertise changes the nature and complexity of that individuals shared task operation will change.During FM operation the individual's student model will continue to be populated with information on the student's action. Information recorded on students choices and actions will be used to tutor the student on missed concepts and misapplied actions in the ITS mode.

The Pseudo-Student mode (PM) will allow the same problem domain operation as in the FM mode. The PM operation will allow a student model, as evolved in the ITS mode, to replace a student's operation atone of MITE's nodes. Any resulting change in expertise levels will cause changes in task assignments for all nodes as appropriate for achieving task objectives.

Phase I: An architecture will be identified for development and integrated operations of the MITE system in all modes; ITS,TEAM FM,and TEAM PM. The MITE system will be developed for networked personal computers (PC)(386 or better) with Windows 3.0 or equivalent memory extensions. The primary development software environment will be NASACLIPS software unless task analysis provides demonstratable results that other software environments would be required to meet MITE system objectives. Three separate problems will be identified that are applicable for MITE task sharing problem solving domain. An early prototype of a one node operation of the MITE system will be developed for concept demonstrated for delivery in the Phase I effort.

Phase II: A three node MITE intelligent tutoring system will be developed, demonstrated and delivered to the federal government. All modes, ITS, TEAM FM and TEAM PM of MITE system operation will be demonstrated. At least two task sharing problems will be included in the demonstration. Complete documentation will be provided on knowledge acquisition accomplished for the ITS knowledge bases,cognitive and simulation modeling for tutoring, training and task sharing operation.

Potential Commercial Market: The MITE System would be applicable in areas requiring highly trained individuals working as a team, such as operators of nuclear power plants and emergency management teams. Individual nodes of Mite would be applicable for individualized training in classrooms, training at remote sites and isolated locations.

TOPIC: A93-018 TITLE: Large Dynamic Range Camera

CATEGORY: Exploratory Development

OBJECTIVE: To develop a camera based on currently available CCDs with a large dynamic range and a 60 Hz frame rate.

DESCRIPTION: A camera with a dynamic range in excess of 20,000:1 is required to serve as the detector in an optical correlator. The device must have a frame rate of at least 60 Hz and a resolution of at least 512 x 512 pixels. It is anticipated that a CCD array would be used; however, other technologies may be considered.

Phase I: The objective of Phase I is to determine the most feasible technology (i.e., CCD, vidicon, etc.) to use in designing a camera with the detailed requirements. A final design and a prototype should be completed in this phase.

Phase II: In Phase II the final camera will be built which will incorporate any corrections made when building the prototype.

Potential Commercial Market: The requested large dynamic range camera has commercial potential in markets where the region of interest contains objects with widely varying illumination. Applications where the scene has objects of interest in both dark shadows and bright sunlight would be one example of where this camera would find widespread use.

TOPIC: A93-019 TITLE: Bacteriorhodopsin Spatial Light Modulator

CATEGORY: Exploratory Development

OBJECTIVE: To develop an erasable, re-writable spatial light modulator based upon the optically active bacterial extract called bacteriorhodopsin.

DESCRIPTION: Spatial light modulators of high spatial resolution and good optical sensitivity are required for applications of optics to automatic target recognition and optical computing. The bacterial extract, bacteriorhodopsin, has high inherent speed and sensitivity in a reaction that causes it to change color when exposed to certain wavelengths of light. This effect shows promise as the basis for a fast and efficient spatial light modulator.

Phase I: The objective of Phase I is to fabricate a bacteriorhodopsin film of high optical quality, and to characterize its performance in terms of sensitivity, spatial resolution, and useful lifetime in terms of write/erase cycles.

Phase II: In Phase II, a working spatial light modulator will be fabricated with dimensions such that it may be placed in an existing optical correlator (target recognition device) for system testing.

Potential Commercial Market: The potential commercial market for bacteriorhodopsin spatial light modulators is unknown.

TANK-AUTOMOTIVE COMMAND (TACOM)

TOPIC: A93-020 TITLE: Real Time Integrity/Durability Monitoring of Composite Structures

CATEGORY: Exploratory Development

OBJECTIVE: Develop the architecture for a neural network to collect data from sensors, in real-time, to monitor the structural health of a vehicle from cradle to grave.

DESCRIPTION: A composite structure reflects its history back to the point of manufacture. Details such as improper cure, dings, impacts,and duty cycle all accumulate with time. The soundness of a composite structure cannot be visually inspected, oftentimes the damage is detectable only to the trained technician. A means by which to monitor the structural health of a vehicle prior to or during operation must be developed.

Phase I: Develop a system architecture for a neural network to interconnect sensors embedded within a composite structure. The system must possess redundancy to avoid the loss of valuable input due to damage from munitions.

Phase II: Construct a thick section composite panel with embedded sensors. Interconnect the sensors using the network developed in Phase I and conduct both structural and ballistic testing to determine the effectiveness of the design.

Potential Commercial Market: One of the reasons composite materials have not been used as much in primary load carrying members is the lack of a reliable means to determine the structural health of components. A company that developed and provided the feasibility of such a technology would be in a good position to sell this technology to the government as well as private aircraft industry.

TEST AND EVALUATION COMMAND (TECOM)

TOPIC: A93-021 TITLE: Vehicle Magnetic Signature Image Enhancement

CATEGORY: Advanced Development

OBJECTIVE: Develop a software system for visually displaying magnetic field strengths about a vehicle silhouette.

DESCRIPTION: Ground vehicles, especially armored vehicles, cause changes in the magnetic field around them as they move. This magnetic field can be measured at various points and a time history of the magnetic field recorded. There is a need to integrate data from many sensors into a group of visual images that show lines of constant magnetic field strength. The basic techniques of how this could be done needs to be explored and sample displays generated from actual test data. Potential commercial use: unknown.

Phase I: Explore techniques and propose a display capability.

Phase II: Initiate a software system for visually displaying magnetic field strengths about a vehicle silhouette.

SIMULATION, TRAINING, AND INSTRUMENTATION COMMAND (STRICOM)

TOPIC: A93-022 TITLE: Simulator/Simulation Based Intelligent Tutoring Systems (ITS)

CATEGORY: Basic Research

OBJECTIVE: Develop the next generation ITSs for training device simulators and simulations.

DESCRIPTION: The Project Manager for Training Devices (PM TRADE)principle mission is transforming training device requirements into systems that embody the essential characteristics of the requirements and permits the Army to accomplish its training mission in an effective manner. These systems take the form of both stand - alone and embedded trainers which almost always use simulation to achieve the training objectives. Training devices and simulators have proven to be an effective tool in transferring information over a broad range of applications. ITSs are an emerging technology field that is gaining visibility within the Army as evidenced by its recognition as the artificial intelligence (AI) subtechnologies broken out for emphasis in the U.S. Army Materiel Command's AI Technology Master Plan(AIMP). Whereas the AIMP promotes a broad based research vision for ITS technology, PM TRADE chooses to focus ITS research efforts in two(2) principle

areas that more closely support its mission: ITSs that incorporate existing simulations into the ITS architecture; and ITSs that are constrained to include simulators/simulations as a component of the ITS design. The distinction between the two areas is subtle but crucial, i.e., in the former case the ITS design must adapt to incorporate a "fixed" simulator/simulation into the architecture and in the latter case a simulator/simulation is an a prior "free" design element under the ITS designer's control. An effective ITS development strategy addresses the ITS architectural and functional component design issues for the two (2) areas first in the context of individual training and then extending those results to the crew/team/combined arms training situations. A ITS testbed would be a key element of any ITS development strategy on which to verify and validate ITS architectures and functional component models. A potentially robust and effective functional ITS architecture has been developed by the RD&E Center of U.S. Army Missile Command in Huntsville, Alabama in support of the Intelligent Embedded Operator Assistant (IEOA) project.

Phase I: Develop ITS architectures, functional component designs/models, and/or test beds

Phase II: Implement architectures, designs/models, and/or test bed design to establish feasibility

Potential Commercial Market: It is anticipated the technology developed under this topic will transfer into the educational and commercial training sectors, especially for those applications for which the knowledge na process tasks to be trained have been appropriately modelled.

ARMY RESEARCH OFFICE (ARO)

TOPIC: A93-023 TITLE: High Dimensionality Decision Module

CATEGORY: Basic Research

OBJECTIVE: Design and analyze a hardware decision module for electronic vision system applications.

DESCRIPTION: A hardware, universal decision module implementing neural-net like algorithms is envisioned for making fast,minimum-probability-of-error decisions in high dimensionality,multi-sensor feature spaces. The decision module must analyze high dimensionality, multi-sensor feature space data of at least ten variables, dynamically adapt to novel and changing environments often in the time of a single video field, be trainable at video field rates using training sets with thousand of data points, and provide decisions at video pixel rates. The decision module will be used in multi-sensor electronic vision systems which perform tasks such as fusing, segmentation, recognition as well as sensor or platform control decisions. In addition to vision systems, this module will be applicable to many other control systems; for example, manufacturing and transportation systems. Any control system in which complex decisions are required may benefit from this work.

Phase I: Complete the design and analysis of a candidate system including simulation of performance bounds.

Phase II: Define the design and implement a demonstration system. Run performance experiments on both synthetic and real vision data.

Potential Commercial Market: In addition to vision systems, this module will be applicable to control systems in manufacturing and transportation, and elsewhere that complex control decisions are required.

BALLISTICS RESEARCH LABORATORY (BRL)

TOPIC: A93-024 TITLE: High Energy Diode Laser Ignition System

CATEGORY: Exploratory Development

OBJECTIVE: Develop Extremely Small High-Energy Diode Lasers, Diode Laser Arrays and Diode Laser-Pumped solid State Laser Systems for the Ignition of Energetic Materials.

DESCRIPTION: The design and construction of extremely small high-energy diode laser systems for the ignition of pyrotechnics, igniter materials and propellants used in large caliber gun is required.

Diode lasers possess the desirable attributes of complete solid-state construction with no moving components, are extremely small and are capable of delivering high energies through optical fibers.

The integration diode laser technology for the initiation of energetic materials, explosives and propellants will therefore have a major impact on the DoD community. The design and construction of both 1) a diode laser or diode laser array and 2) a diode laser pumped solid-state laser such as Nd: YAG or Ti-Sapphire are needed to ignite pyrotechnics, black powder and solid propellants used in large caliber gun. Desirable specifications are 1 Joule of energy per single 10 ms pulse, optical fiber output and compactness (8x4x4 in, all electronics and components).

Phase I: An engineering and design study which will attempt to meet the aforementioned specifications. The delivery of a simple prototype single diode laser based system is desirable.

Phase II: Construction of both diode laser-based ignition systems as described above and delivery to BRL for test and evaluation.

Potential Commercial Market: Production of commercially marketable diode laser initiation systems for application in both DoD and industrial sectors by contractor is expected.

HARRY DIAMOND LABORATORY (HDL)

TOPIC: A93-025 TITLE: Noise Filters

CATEGORY: Exploratory Development

OBJECTIVE: To explore the utility of adaptive techniques based on explicit characterization of interfering sounds in the design and development of robust acoustic detection and classification.

DESCRIPTION: Previous work has shown that with proper adaptive learning schemes, interfering acoustic signals (which tend to obscure or be misrecognized as one of the desired acoustic signatures) can be automatically identified, characterized, compared to and deleted from an incoming acoustic data stream. This process exposes a desired signature buried in a very obscure environment. In a typical use of this approach, sounds that tend to obscure or be misrecognized as a desired signature, are fashioned, both during training and on the fly,into templates defining error classes. These templates are then used to identify and suppress signals form the error classes, leaving a residual with improved SNR for template matching against reference templates. Systems containing sensitivity in poorly understood and rapidly changing acoustic environments by reducing recurrent false positives, while permitting retrofit implementation on template matching systems currently in use.

Phase I: Proof of concept. Develop and code algorithms and exercise in a suitable simulation testbed. Effort focuscd on demonstrating ability to perform detection and upon classification accuracy, rather than on real time performance.

Phase II: Technology Demonstrator. Optimize and implement the Phase I designs using hardware appropriate for responsive real time decision making performance. Demonstrate effectiveness in a setting in which selected cultural sounds are discriminated in low and variable signal-to-noise and signal-to-clutter ratios.

Potential Commercial Market: (1) Robotics; (2) Medical: Auditory Speech Recognition; (3) Acoustic Medical Responses.

HUMAN ENGINEERING LABORATORY (HEL)

TOPIC: A93-026 TITLE: Virtual Reality Environment as Control Interface for Unmanned Ground Vehicles (UGVs)

CATEGORY: Exploratory Development

OBJECTIVE: Develop a virtual reality environment control interface for operation and simulation of operation of robotic unmanned ground vehicles (UGVs).

DESCRIPTION: The teleoperation of UGVs requires a control interface which may be used by a human operator with as few difficulties as human factors allow. Choosing a suitable control interface requires determination, through human factors studies, of limitations and preferences of human operators for operation of an UGV. A problem arises in the study of these human factors in that existing control interfaces can not be easily reconfigured to isolate individual interface elements for these human factors studies to be performed.One solution to this problem is to have a virtual reality environment with

features that allow a human operator to teleoperate a vehicle from within the environment. A non-inclusive list of features includes stereo vision, tactile feedback (for direct manipulation of interface element representations), graphics/real-time video composite imaging. This virtual reality environment would also be used as the final control interface for UGVs.

Phase I: This phase shall establish hardware and software requirements for the development of the virtual reality environment control interface described above. These requirements shall include a description of the overall system design strategy to develop a virtual reality environment control interface which includes such feedback mechanisms as stereo vision, tactile feedback, and graphics/real-time video composite imaging. Other design requirements are the commercial availability of necessary system components (both hardware and software), and cost. The final output of Phase I shall be a report defining the feasibility of achieving requirements and suggested alternative solutions where requirements are unachievable.

Phase II: This phase shall be directed towards fabricating an operating prototype of the virtual reality environment control interface to be used in human factors studies of the teleoperation of UGVs.

Potential Commercial Market: The commercial applications of a developed virtual reality environment as control interface for UGVs could include, while not excluding others, a single generic reconfigurable control interface which could operate a variety of teleoperated platforms ranging from such machines as industrial robotic manipulator arms to wheeled/tracked mobile surveillance vehicles to heavy construction vehicles/equipment. In industrial situations, a single or few interfaces could be used to operate many different systems. An additional area of commercial application would be the simulation for platform operation or the simulation of dangerous environments for the purposes of training personnel such as police, firemen, hazardous materials handlers, bomb disposal specialists, as well as others.

TOPIC: A93-027 TITLE: Development of an Auditory Signal Processing System

CATEGORY: Advanced Development

OBJECTIVE: To develop a hardware/software system that will enhance auditory signals which are degraded by noise.

DESCRIPTION: The advancement of dedicated signal processing integrated circuits has made possible the processing of auditory signals in real-time. There is a need in the Army for a processor that will recover, in real-time, signals which are embedded in noise. These signals include speech signals which may be either airborne or transmitted over communication systems, or may be combat related sounds. Field use of the processor may require that it be worn unobtrusively, therefore consideration should be made for future miniaturization of the device.

Phase I: Phase I of this project will include the selection or development of the signal enhancement algorithm(s). It will also include the definition of the hardware required to implement the selected algorithm(s) and the definition and outline of the software that will be written to implement the signal processor. Phase I will also provide an indication, through a demonstration, that the concept has a reasonable chance of succeeding.

Phase II: Phase II will require a hardware system and software for the auditory signal processor. Phase II will also include extensive human subject evaluation of the processor to optimize its capabilities and to demonstrate the ability of the system to enhance degraded speech and other signals. Both the signals and the noise will have varying spectral and temporal characteristics. Phase II will also address miniaturization of the processor.

Potential Commercial Market: Hearing aid manufacturers and telephone companies.

MATERIALS TECHNOLOGY LABORATORY (MTL)

TOPIC: A93-028 TITLE: Nondestructive Evaluation Method for Environmental Deterioration of Fiber-Reinforced Organic Matrix Composites

CATEGORY: Exploratory Development

OBJECTIVE: Develop a spectroscopic, or equally effective,nondestructive evaluation (NDE) system to evaluate the environmental durability of fiber-reinforced, organic matrix composites.

DESCRIPTION: The structural behavior of advanced composite materials and structures is known to be affected by natural/accelerated weathering and other in-service environmental/loading conditions.Material deterioration occurs via a combination of temperature,humidity, service loads, and photothermal and photo-oxidative mechanisms. This results in chemical changes, plasticization of the resin, fiber blooming, fiber/matrix debonding, microcracking, lowering of the glass

transition temperature of the matrix, and a reduction of the mechanical properties. The degree of degradation depends on the severity and duration of environmental exposure, loading conditions,and the type of composite and coating. An NDE technique is needed to assess the level of deterioration of organic-based materials in the field and for predicting the lifetime of critical high-performance composite structures used in Army systems. The proposed spectroscopic system must be practical, field-portable, environmentally safe and not affect the structural performance of the composite.

Phase I: Demonstrate the feasibility of characterizing the moisture effects and chemical changes that result from natural and/or accelerated weathering of fiber-reinforced organic matrix composites.This demonstration should employ a spectroscopic or equally effective NDI technique and evaluate these effects in fiberglass, Kevlar, and graphite reinforced composites with both epoxy and polyester matrices.

Phase II: Develop and deliver an optimized, automated,field-portable, prototype of the spectroscopic NDE system addressed in Phase I. Demonstrate the capability of this prototype to assess environmental deterioration on full-scale composite structures used in Army systems.

Potential Commercial Market: A new automated non-destructive evaluation system to assess the environmental deterioration of composite structures in military and commercial markets.

CONSTRUCTION ENGINEERING RESEARCH LABORATORY (CERL)

TOPIC: A93-029 TITLE: Construction and Rehab Materials Made From Recycled Post-Consumer Wastes

CATEGORY: Exploratory Development

OBJECTIVE: The objectives of this effort are: (1) to assess the opportunities for the development of innovative construction materials from recycled waste products and (2) to manufacture and demonstrate selected innovative construction material systems that have a high potential for success.

DESCRIPTION: Due to the volume of waste materials being sent for disposal, our landfills are being filled at a critical rate. Soon we will have no place to put our garbage. This situation has generated increased recycling efforts across the Nation. However, for there cycling process to be successful, there must be a market or outlet for the recycled "raw" materials. Many times the recycled material can not be used in the same manner as the virgin material. The potential exists, however, for these recycled "raw" materials to be utilized as a construction and/or rehab material. Plastics, paper (e.g., newspaper, telephone books and magazines) and byproduct materials like fly ash comprise a significant fraction of the total waste volume. The above mentioned materials have been used to some extent to produce other products such as plastic lumber,building insulation and concrete. The potential raw material volume can support many other uses of these recycled waste materials.Innovative construction material systems are needed that make optimum use of these waste materials yet produce equal or superior materials for the construction and/or rehab of facilities. Fiber reinforced composites made from recycled plastics or lightweight construction blocks/bricks made from fly ash are possible examples.

Phase I: Analyze and assess the opportunities for the development of various construction materials made from recycled waste products.

Phase II: Manufacture selected materials that show the most promise and demonstrate their performance in a constructed facility.

Potential Commercial Market: With the increasing National emphasis on the use of recycled materials for just about everything, the market potential for successfully developed new and innovative construction materials made with recycled wastes is high.

TOPOGRAPHIC ENGINEERING CENTER (TEC)

TOPIC: A93-030 TITLE: Texture Library for 3-Dimensional Visualization Systems

CATEGORY: Exploratory Development

OBJECTIVE: Develop an effective approach to create and populate a common texture library for use in simulators, training devices,mission rehearsal systems and weapon systems under development.

DESCRIPTION: The use of simulators and image generators in the Army for a variety of tasks, including training and mission rehearsal is rapidly growing. To be effective, these systems require a high degree of realism in the computer generated scenes. Increased detail of 3D models, objects, and local features (both natural phenomena and cultural features, such as water bodies, grassland, forest, crops,road surfaces, buildings, etc.) shown in these scenes could be accomplished through rapid retrieval of color texture patterns stored in a digital library for subsequent use. The library approach will help eliminate the need for individual Army systems to generate texture libraries and promote common understanding of the computer generated scenes.

Phase I: Study existing methods of graphics texturing, including fractal, statistical, locally controlled, context-sensitive, and photo-derived techniques for modulating the color of 3D models,objects, and local features shown in 3D computer generated scenes.Devise a classification scheme for a texture library based on texturing methods and object types. Develop a method for creating a digital library of textures, addressing issues such as algorithms for creating mathematical based textures and image compression techniques for storage and retrieval to and from the library. The effort should culminate in a report on texturing methods and compression techniques,and include a recommended design approach for a texture library.

Phase II: Populate and deliver a texture library on a suitable storage media.

Potential Commercial Market: Phase III potential should be high. The texture library should be a product with strong need in the rapidly growing DoD modelling and stimulation community and in commercial advertising and civil engineering business sectors.

TOPIC: A93-031 TITLE: Development of a Surface Microroughness Compilation

CATEGORY: Exploratory Development

OBJECTIVE: Develop a strategy for compilation of surface microroughness for input to the Condensed Army Mobility Modeling System (CAMMS).

DESCRIPTION: The Army currently uses inference techniques to estimate the surface microroughness of a geographic area. These techniques are necessarily less accurate than if the Defense Mapping Agency provided the information directly from source imagery.

Phase I: Identify one or more compilation strategies that could be implemented in the DPS environment to reliably extract surface microroughness.

Phase II: Extend this strategy worldwide.

Potential Commercial Market: Phase III potential should be good for marketing this product to both domestic and foreign defense customers and for private sector firms that design military vehicles.

MEDICAL RESEARCH ACQUISITION ACTIVITY (MEDICAL)

TOPIC: A93-032 TITLE: Neurotoxins

CATEGORY: Basic Research

OBJECTIVE: Identify appropriate model systems for the study of agent effects and investigate countermeasure approached for neurotoxins such as botulinum toxin and saxitoxin. Identify antibodies (antitoxins)directed against common features of neurotoxin molecules that in themselves do not have central nervous system side effects. Develop reagents that rapidly identify neurotoxins either specifically or as members of a neurotoxin class.

DESCRIPTION: After conducting a thorough literature search, use novel techniques to investigate the mechanisms of action of neurotoxin damage. Investigate pre/treatment regimens.

Phase I: Preliminary data that will show the concept feasibility and their merit of further investigation.

Phase II: Experimentation that will demonstrate the practicality of the research as it relates to military medical defense.

Potential Commercial Market: Several militarily relevant toxins (e.g.,saxitoxin, botulinum toxin) present significant public health hazards through oral ingestion. No specific treatment regime exists. Model systems for studying these agents resulting in antitoxins for treatment against these toxins would be a significant advance in protecting the public health.

TOPIC: A93-033 TITLE: A Transducer/Equipment System for Capturing Speech Information for Subsequent Processing by Computer Systems

CATEGORY: Exploratory Development

OBJECTIVE: Develop, optimize, and test a noise-canceling (or superior) transducer/equipment system to capture high quality speech information from active soldiers i the field for subsequent processing by computer systems.

DESCRIPTION: Specifically, this noise-canceling transducer/-equipment system must yield high quality speech information under the following conditions: 1) High level ambient noises, e.g., 100 db, 2)High-intensity impulse acoustic noises, e.g., firing of tank or howitzer, 3) Sensing speech from soldiers who are physically active,4) High ambient environmental temperatures and humidities, e.g., 38 degrees centigrade and 90% r.h., 5) Pulsed and continuous e-m noise from computers, radios, radars, 6) Sensing speech from soldiers wearing various helmets and clothing systems which restrict options for transducer attachment and placement, e.g., MOPP1 versus MOPP4, 7) The transducer/equipment system must be relatively non-invasive and comfortable for the soldier to wear for 12-15 hours, and 8) The system can not use electrical power from an external source. Soldiers will answer queries about symptoms, well-being, or perceived capabilities while they are performing their duties. Also, measures of operational performance for military tasks involving communications such as requested for fire support or sending of planned target lists will be collected by computer systems. Thus, demonstrating the feasibility of this transducer/equipment system is a necessary and critical "first step" towards the ultimate application of computer systems to collect and analyze symptoms, moods, and performance data from soldiers in real-time in training centers, the laboratory, and the field with minimal interference to ongoing soldier activities.

Phase I: To the extent possible, design and assemble a noise-canceling (or superior) transducer/equipment system from off-the-shelf previously evaluated components to faithfully sense speech in the laboratory for the conditions described above. Fabricate new or modify existing components as needed. Demonstrate proof of concept of r the proposed system by laboratory test and provide documentation describing methodology and test results.

Phase II: Optimize, assemble, and test a noise-canceling (or superior) transducer/equipment system that can be worn by the soldier,which includes high quality, high level (0.2V) audio output, an earphone (so that researchers can communicate with the soldier), and an interface for connection to other existing audio data collection and audio communications equipment. The feasibility and performance of this transducer/equipment system will be demonstrated by technical documentation and a field test that shows high quality speech information can be acquired, recorded and processed under realistic conditions described above. Deliver a functional prototype system for further evaluation and testing by Government personnel.

Potential Commercial Market: Products of this research would have a broad-based commercialization potential for application in management of any activity or operation controlled by a computer. Most specific applications would be in noisy operating environments, such as in industry, in which data input is required through computer technology in controlling operations.

TOPIC: A93-034 TITLE: Instrumentation For Measurement Of Body Chemical Element Content

CATEGORY: Exploratory Development

OBJECTIVE: Fabricate and test a device to measure amount and distribution of nitrogen and calcium by scanning the entire human body.

DESCRIPTION: A requirement exists for new research instrumentation to make rapid, precise, in vivo measurements of human body chemical element content using new nuclear techniques. Such instrumentation should allow rapid, routine assessment of nitrogen and calcium content in individual soldiers. Any radiation dose associated with proposed instruments should be low enough that serial measurements will be possible with a low risk to the subject. In addition, proposed

instruments should not have unusual power requirements and should be sufficiently compact to be transportable. The possibility of measuring element distribution in the body with centimeter-scale resolution should also be addressed.

Phase I: Develop a viable device and collect sufficient laboratory test data to demonstrate feasibility.

Phase II: Construct and test a working prototype; demonstrate the required operational capability in the laboratory; deliver a transportable system suitable for government field testing.

Potential Commercial Market: Moderately high for instrumentation capable of monitoring body composition changes, with particular relevancy in the areas of nutritional status evaluation of an individual, and in the application area of sports medicine. In addition, monitoring of body homeostasis with regard to calcium content has specific relevancy to evaluation and treatment of women suffering from osteoporosis and related bone diseases.

STRATEGIC DEFENSE COMMAND (SDC)

TOPIC: A93-035 TITLE: Performance Upgrade Kit for AN/MPS-36 Radars

CATEGORY: Basic Research

OBJECTIVE: Improve performance of AN/MPS-36 Tracking Radars via Kit Type Modifications.

DESCRIPTION: The AN/MPS-36 tracking radar is in use at several test ranges. Although piecemeal upgrades to individual An/MPS-36 radars have been made, it is desirable to lower the per-radar non-recurring engineering cost by developing a modification kit. The kit should at minimum alleviate spiraling and crosstalk problems associated with the AN/MPS-36 radars. Ideally, the kit will improve reflector characteristics and use state of the art technology to upgrade feed/receiver subsystems.

Phase I: Phase I will prove/disprove concept feasibility, outline design and test methodologies, present the Phase II project management philosophy and provide a rough order of magnitude cost for kit prototyping and production.

Phase II: Phase II will result in the production of a prototype kit,and include installation and testing of the kit on one of the Kwajalein Missile Range (KMR) AN/MPS-36 radars. Phase II proposals should also include an assessment of commercial markets for the radar modification kit.

Potential Commercial Market: Anticipated benefits/commercial applications could aid the NASA community in tracking and identifying space debris.

TOPIC: A93-036 TITLE: Transmitter Upgrade Kit for AN/FPQ-19 Radars

CATEGORY: Advanced Development

OBJECTIVE: Improve multiple beacon Tracking Capability

DESCRIPTION: An ability to utilize the An/FPQ-19 for tracking multiple beacons having different up and down-link frequencies will ease Kwajalein Missile Range sensor allocation constraints. One of the modifications necessary to accomplish effective multiple beacon tracking is an ability to digitally tune the transmitter to any point within its 500 Mhz bandwidth. tuning to any frequency must be accomplished rapidly, with a tuning time less than the maximum pulse repetition frequency being desirable. The transmitter modification should be in kit form, and be suitable for installation on similar radars with minimal modification.

Phase I: Phase I will prove/disprove concept feasibility, outline design and test methodologies, present the Phase II project management philosophy and provide a rough order of magnitude cost for kit prototyping and production.

Phase II: Phase II will result in the production of a prototype kit,and include installation and testing of the kit on the KMR AN/FPQ-19 radar. Phase II proposals should also include an assessment of commercial markets for the radar modification kit.

NAVY

Proposal Submission

The responsibility for the implementation, administration and management of the Navy SBIR program is with the Office of the Chief of Naval Research. The Navy SBIR Program Manager is Mr. Vincent D. Schaper. Inquiries of a general nature may be brought to the Navy SBIR Program Manager's attention and should be addressed to:

Office of the Chief of Naval Research
ATTN: Mr. Vincent D. Schaper
800 North Quincy Street, BCT #1, Room 922
Arlington, VA 22217-5000
(703) 696-4286

SBIR proposals shall not be submitted to the above address and must be received by the cognizant activities listed on the following pages in order to be considered during the selection process.

The Navy's mission is to maintain the freedom of the open seas. To that end the Navy employs and maintains air, land and ocean going vehicles and personnel necessary to accomplish this mission. The topics on the following pages represent a portion of the problems encountered by the Navy in order to fulfill its mission.

The Navy has identified 132 technical topics in this, the first of two SBIR solicitations to be released during FY 1993 by DOD to which small R&D businesses may respond. The Navy has experienced a reduction in its SBIR funding and this is reflected in the amount of topics in this solicitation. While the reduction in funds will not impact the Phase I awards that result from the topics listed in this solicitation, it makes it extremely important that Phase I award recipients influence the end uses of the technology since Phase II SBIR funds will be limited and thus highly competitive.

This solicitation also contains several new formatting ideas: 1) we have provided Phase III information for many topics, 2) for about 25% of the topics we have identified possible areas where a commercial potential may exist and, 3) in at least three topics, the topic descriptions are extremely broad. I would appreciate your comments and suggestions on these format changes.

Selection of proposals for funding is based upon technical merit and the evaluation criteria contained in this solicitation document. Because funding is limited the Navy reserves the right to limit the amount of awards funded under any topic and only those proposals considered to be of superior quality will be funded.

NAVY SMALL BUSINESS INNOVATION RESEARCH PROGRAM

Submitting Proposals on Navy Topics

Phase I proposal (5 copies) should be addressed to:

Topic Nos. N93-001 and N93-002

Administrative SBIR Contact

Mail/Handcarry Address:

Office of Naval Technology
Attn: Code ONT 20P22, Room 502
SBIR Program, Topic No. N93-_____
800 N. Quincy Street, BCT #1
Arlington, VA 22217-5000

Mr. Doug Harry
(703) 696-4453

Topic No. N93-003 through N93-005

Mail/Handcarry Address:

Office of Advanced Technology
Attn: Code OAT 31, Room 922
SBIR Program, Topic No. N93-_____
800 N. Quincy Street, BCT #1
Arlington, VA 22217-5000

Mr. William Slowik
(703) 696-1299

Topic Nos. N93-006 through N93-017

Mail Address:

Commander
Marine Corps Systems Command
Attn: Code AW, SBIR Program, Topic No. N93-_____
Quantico, VA 22134-5080

Mr. Robert Stith
(703) 640-4801/2761

Handcarry Address:

Commander
Marine Corps Systems Command
Attn: Code AW, SBIR Program, Topic No. N93-_____
Building #3097, 2nd Deck, Room 13
Quantico, VA 22134-5080

Topic Nos. N93-018 through N93-043

Mail Address:

Commander
Space and Naval Warfare Systems Command
Attn: Code SPAWAR OOK, SBIR Program, Topic No. N93-_____
Washington, DC 20363-5100

Ms. Betty Geesey
(703) 602-6092

Handcarry Address:

Commander
Space and Naval Warfare Systems Command
Attn: Code SPAWAR OOK, SBIR Program, Topic No. N93-_____
Crystal Park #5, Room 110
2451 Crystal Drive
Arlington, VA 22202

Administrative SBIR Contract

Topic Nos. N93-044 and N93-045

Mail Address:

Commander
Naval Supply Systems Command
Attn: Code SUP 4233D, SBIR Program, Topic No. N93-_____
Washington, DC 20376-5000

Ms. Linda Whittington
(703) 607-1648

Handcarry Address:

Commander
Naval Supply Systems Command
Attn: Code SUP 4233D, SBIR Program, Topic No. N93-_____
Crystal Mall #3, Room 710
1931 Jefferson Davis Highway
Arlington, VA 22202

Topic Nos. N93-046 through N93-048

Mail Address:

Commander
Naval Air Systems Command
Attn: Code AIR-05TE2, SBIR Program, Topic No. N93-_____
Washington, DC 20361

Ms. Cathy Nodgaard
(703) 692-7393

Handcarry Address:

Commander
Naval Air Systems Command
Attn: Code AIR-05TE2, SBIR Program, Topic No. N93-_____
1411 Jefferson Davis Highway
Jefferson Plaza #1, Room 444
Arlington, VA 22202

Topic No. N93-049

Mail Address:

Commanding Officer
Naval Medical Research and Development Command
Attn: Code NMRDC-42, SBIR Program, Topic No. N93-_____
Bethesda, MD 20889-5044

CDR Jim Beddard
(301) 295-0885

Handcarry Address:

Commanding Officer
Naval Medical Research and Development Command
Attn: Code NMRDC-42, SBIR Program, Topic No. N93-_____
6700 Wisconsin Avenue
Building #1, 12th Floor
Bethesda, MD 20889-5044

Topic Nos. N93-050 through N93-080

Mail Address:

Commander
Naval Sea Systems Command
Department of the Navy/NAVSEA
Attn: Code 06HE, SBIR Program, Topic No. N93-_____
Washington, DC 22202

Mr. William Degenteah
(703) 602-3005

Handcarry Address:

Commander
Naval Sea Systems Command
Attn: Code 06HE, SBIR Program, Topic No. N93-_____
Crystal Plaza #5, Room 924
2211 Jefferson Davis Highway
Arlington, VA 22202

Topic Nos. N93-081 through N93-105

Mail Address:

Commander
Naval Surface Warfare Center
Dahlgren Division
Attn: Code R05, SBIR Program, Topic No. N93-_____
Silver Spring, MD 20903-5000

Mr. Donald Wilson
(301) 394-1279

Handcarry Address:

Commander
Naval Surface Warfare Center
White Oak Detachment
Attn: Code R05, SBIR Program, Topic No. N93-_____
Building #1, Reception Room
Silver Spring, MD 20903-5000

Topic Nos. N93-106 through N93-114

Mail Address:

Commander
Naval Undersea Warfare Center
Detachment New London
Attn: Code 0911, SBIR Program, Topic No. N93-_____
New London, CT 06320-5594

Mr. Jack Griffin
(203) 440-4116

Handcarry Address:

Commander
Naval Undersea Warfare Center
Detachment New London/Shaw's Cove
Attn: Code 0911, SBIR Program, Topic No. N93-_____
Office Park, Building #4
New London, CT 06320-5594

Topic No. N93-115

Mail Address:

Commanding Officer
Naval Air Warfare Center
Aircraft Division Warminster
Attn: Code 01B, SBIR Program, Topic No. N93-_____
P.O. Box 5152
Warminster, PA 18974-0591

Ms. Carol Van Wyk
(215) 441-2375

Handcarry Address:

Commanding Officer
Naval Air Warfare Center
Aircraft Division Warminster
Attn: Code 01B, SBIR Program, Topic No. N93-_____
Street Road/Jacksonville Road
Warminster, PA 18974-0591

Topic No. N93-116 and N93-117

Mail Address:

Commanding Officer
Naval Air Warfare Center
Aircraft Division Trenton
Attn: Code PE31, SBIR Program, Topic No. N93-_____
6250 Phillips Boulevard
Trenton, NJ 08628-0176

Mr. Robert Dobrowolski
(609) 538-6754

Handcarry Address:

Commanding Officer
Naval Air Warfare Center
Aircraft Division Trenton
6250 Phillips Boulevard
Trenton, NJ 08628-0176

Topic Nos. N93-118 through N93-121

Mail Address:

Commanding Officer
Naval Command, Control and Ocean
Surveillance Center (RDT&E) Division
Attn: Code 21, SBIR Program, Topic No. N93-_____
San Diego, CA 92152-5000

Mr. Joseph Michel
(619) 553-3226

Handcarry Address:

Commanding Officer
Naval Command, Control and Ocean
Surveillance Center (RDT&E) Division
Attn: Code 21, SBIR Program, Topic No. N93-_____
271 Catalina Boulevard
San Diego, CA 92152-5000

Topic Nos. N93-122 and N93-123

Mail Address:

Commander
Naval Surface Warfare Center
Carderock Division
Attn: Code 0112, SBIR Program, Topic No. N93-_____
Bethesda, MD 20084-5000

Mr. Frank Halsall
(301) 227-1094

Handcarry Address:

Commander
Naval Surface Warfare Center
Annapolis Detachment/Carderock Division
Attn: Code 0112, SBIR Program, Topic No. N93-_____
Building #1, Room 211
Bethesda, MD 20084-5000

Topic Nos. N93-124 through N93-132

Mail/Handcarry Address:

Commanding Officer
Naval Civil Engineering Laboratory
Attn: Code L03BPM, SBIR Program, Topic No. N93-_____
Port Hueneme, CA 93043-5003

Mr. Nicholas Olah
(805) 982-1089

SUBJECT/WORD INDEX TO THE NAVY SBIR SOLOCITATION

DEPARTMENT OF NAVY TOPIC TITLES
SOLICITATION 93.1

OFFICE OF NAVAL TECHNOLOGY

N93-001 Space-Based Detection of Surface Platforms

N93-002 Automated Oceanographic Imagery Information

OFFICE OF ADVANCED TECHNOLOGY

N93-003 Advanced Systems and Technologies for Future Naval Warfare

N93-004 Technology for Affordability

N93-005 Technology Improvement

MARINE CORPS

N93-006 Laser Discrimination

N93-007 Multi-Purpose Tactical Antenna

N93-008 Receive-Only Radio Equipment

N93-009 Refrigeration for Combat Medical Units

N93-010 Miniature Electrical Generators

N93-011 Advanced Weapons Material: Exterior Surface

N93-012 Advanced Weapons Material: Interior Surface.

N93-013 Target Acquisition & Fire Control Solution

N93-014 Countermine Multisensor Fusion Detection Device

N93-015 Real-Time Image Fusion

N93-016 Command Communications System Interface for Amphibious and Land Combat Vehicles

N93-017 All-Consumable Ration Pack

SPACE AND NAVAL WARFARE SYSTEMS COMMAND

N93-018 Constraints and System Primitives in Achieving Multilevel Security in Real time Distributed Systems Environments

N93-019 Tactical Data Transfer Protocol Accelerator

N93-020 Multi-Network Engineering Tool

N93-021 Critical-Time/Real-Time Database Management

N93-022 Composibility Constraints of Multilevel Systems

N93-023 New Electronic Warfare (EW) Identification (ID) Techniques

N93-024 Inter-Service Voice Communications Model

N93-025 Virtual Information Transfer Emulator (VITE)

N93-026 HF Emulator for Adaptive Reception (HEAR)

N93-027 Satellite Communications (SATCOM) Multi-Band Antennas

N93-028 Flexible Bit Rate Voice

N93-029 Broadband Submarine Communications Mast Antenna

N93-030 Submarine RF Communications Antenna

N93-031 Development of a Planar Lens or Reflector for a Multiple-Beam Multi-Mission Broadband Antenna (MMBA)

N93-032 Artificial Intelligence Tools for EHF SATCOM Management

N93-033 Data Structures and Architectures for Automated Image Interpretation

N93-034 Multi Sensor Data Visualization of Meteorological Features

N93-035 Environmental Data Base Compression

N93-036 Machine-assisted submarine passive acoustic classification

N93-037 Adaptive Processing for Shallow Water Low Frequency Active Operations (LFA)

N93-038 Coherent Processing for LOFARGRAMS

N93-039 Transporting Ada and C Software to Arbitrary Processor Architectures Efficiently

N93-040 Acoustic Warfare Management System

N93-041 Automated signal processing for the Integrated Undersea Surveillance System

N93-042 Logistics Technology Forecast Tool for Hardware and Software including NDI

N93-043 Automatic Detection and Tracking of Acoustic Signals of Low Signal-to-Noise Ratio (SNR) Using Innovative Beamforming and Three-Dimensional Tracking Algorithms

NAVAL SUPPLY SYSTEMS COMMAND

N93-044 Industrial/Supply Information Interface Development

N93-045 Application of Desktop Manufacturing to Part Digitizing Systems

NAVAL AIR SYSTEMS COMMAND

N93-046 TOMAHAWK Command Information Accountability in a GLOBIXS Network

N93-047 Fiber-optic Bundle Reliability Improvement Analysis

N93-048 Field Replacement and Mass Discrete Retermination of V-22 Connectors/Flat Wire Cables Without Solder

NAVAL MEDICAL COMMAND

N93-049 Non-invasive In Vivo Tissue Bubble Detector

NAVAL SEA SYSTEMS COMMAND

N93-050 SSN21 Battery Floating Voltage Equalizer

N93-051 Crevice Corrosion Prevention

N93-052 Electromagnetic Interference Qualification of Submarine Components by Extension

N93-053 Fault Tolerant Processor (FTP) Life Cycle Maintenance

N93-054 Remote Battery Disconnect

N93-055 Light Weight Syntactic Foam

N93-056 Galley Exhaust Hood Improvement

N93-057 Seawater Distilling Plant Steam Overpressure Trip Valve

N93-058 Effect of Fouling on Acoustic Performance of Fan Outlet Devices

N93-059 Improved Adhesives for Seawater Applications

N93-060 Methodology and Tools for Improving Logistics Information Systems in Ship Acquisition and Support

N93-061 Methodology and Tools for Improving the Effectiveness of Acquisition Logistics Training

N93-062 Microwave Filter

N93-063 Near Ocean Environment Sensor

N93-064 Sensor Tactical Decision Aid

N93-065 Frequency Synthesizer

N93-066 Mechanical Seal(s) for Contra-Rotating Propulsion Shafts

N93-067 Structural Fabrication Tolerances and Structural Details

N93-068 Use of Composite Material for MCM Aft Deck Machinery

N93-069 Methods to Reduce Emissions from Diesel Engines

N93-070 Under-ice Remote Detection System (RDS)

N93-071 Tactical Oceanography Support of Mining and Mine Countermeasures Operations

N93-072 Multi-Warfare Tactical Decision Aid

N93-073 Sonar Search Tactics Optimization

N93-074 Surface Ship and Submarine Automated Acoustic Search Planning

N93-075 Standard Low Cost Display Console

N93-076 Passive Automation

N93-077 Supportability of Commercial-Off-The-Shelf (COTS) Products in Military Systems.

N93-078 Utilization of high resolution color displays for sonar data

N93-079 High Frequency (HF) Skywave Recognition Using Small Baseline Antenna Arrays

N93-080 Knowledge based Processing as applied to reduced manning

NAVAL SURFACE WARFARE CENTER/DAHLGREN

N93-081 Low Cost Miniature G-Hardened Inertial Navigation Sensor (INS) for Gun Launched Projectiles

N93-082 Long-Life Lithium Thermal Battery Technology

N93-083 Energetic Phosphazene Polymers

N93-084 Near-Real-Time Data Fusion

N93-085 Improved Underwater Target Identification Through Optical Processing

N93-086 Safe, High Performance Rechargeable Batteries for Underwater Vehicle Propulsion

N93-087 Refractory Diboride Composites

N93-088 Low-Earth Orbit Environment

N93-089 System Dependability Assessment Methodology

N93-090 High Speed Optical Processing for Antisubmarine Warfare

N93-091 Real-time Optical Synthetic Aperture Radar Signal Processing

N93-092 Coatings for Diamond Films Used on High Speed Missiles

N93-093 Optical Postprocessing Module for Improved Underwater Target Identification

N93-094 Process Development for a New Oxidizer for Navy Missile Propellants

N93-095 Miniature, G-Hardened, Fast Acquisition GPS Inertial Navigation Sensor (GPS/INS)

N93-096 Low Cost Control System Components for Gun Launched Projectiles

N93-097 Multimode FEL Based Tracking Sensor

N93-098 Self Adjusting Obturator

N93-099 Instrument for In-Situ Measurements of Special Hull Treatments

N93-100 Rapid Detection Methods for Biocorrosion

N93-101 Formulation of Method to Integrate Design Views

N93-102 Driver for Pointer-Tracker Radar Systems

N93-103 Explosions of Coated Boron Particle Clouds in Air

N93-104 Electromagnetic Millimeter Wave Nondestructive Evaluation of Radomes

N93-105 Equipment Specification Authoring Tool with Multimedia

NAVAL UNDERSEA WARFARE CENTER/NEW LONDON

N93-106 Visualization of Complex Active Sonar Information

N93-107 Composite Periscope Mast

N93-108 Multispinning of directionally solidified terbium-dysprosium

N93-109 Low Storage Volume Vertical Array

N93-110 Alternate Periscope Antenna Radome Development

N93-111 Nondestructive Inspection Techniques for Composite Material Components

N93-112 Shallow Water Sonar Model for 10 Kilohertz through 500 Kilohertz

N93-113 High Energy Density Propulsion Systems for Underwater Vehicles

N93-114 Active Vibration Isolation

NAVAL AIR WARFARE CENTER/WARMINISTER (NAVAL AIR DEVELOPMENT CENTER)

N93-115 Satellite Imagery Transmission Technology Development

NAVAL AIR WARFARE CENTER/TRENTON (NAVAL AIR PROPULSION CENTER)

N93-116 Development of a Barkhausen Noise Technique for Aeronautical Bearings and Gears

N93-117 Helicopter/Tilt-Rotor Gear Box Debris Monitoring System

NAVAL COMMAND, CONTROL & OCEAN SURVEILLANCE CENTER
RDT&E DIVISION (NAVAL OCEAN SYSTEMS CENTER)

N93-118 Thermally Conductive Coatings for Aluminum Hardware

N93-119 Multi-Octave Passive VHF/UHF Antenna Technology

N93-120 Integrated Broad Band Receiver-Transmitter Technology

N93-121 Tunable Narrow Band Optical Filters for the Blue-Green Spectral Region

NAVAL SURFACE WARFARE CENTER/CARDEROCK (DAVID TAYLOR RESEARCH CENTER)

N93-122 Malone Cycle Compressor and Expander

N93-123 Active Control Systems For Ship Silencing

NAVAL CIVIL ENGINEERING LABORATORY

N93-124 Fuel Oil and AFFF Removal

N93-125 Non-disturbing Asbestos Detection System

N93-126 Decontamination of Pentachlorophenol (PCP)-Treated Wood

N93-127 Determination of Factors Affecting Complete Mineralization of Ordnance Compounds (TNT)

N93-128 Soil Slurry Bio-reactor for Ordnance Compounds

N93-129 Lead Hyperaccumulators

N93-130 Subsurface Landfill Barrier

N93-131 Rapid High Rate Lead in Air Monitor

N93-132 NDT Technique(s) for Detecting Delaminations in High Temperature Pavements

DEPARTMENT OF NAVY
SBIR TOPIC DESCRIPTIONS
SOLICITATION 93.1

OFFICE OF NAVAL TECHNOLOGY

N93-001 TITLE: Space-Based Detection of Surface Platforms

CATEGORY: Exploratory Development

OBJECTIVE: Develop algorithms to process automatically multi-channel satellite imagery to detect anomalous curvilinear features in clouds, such as those induced in low level clouds by ships below ("ship tracks").

DESCRIPTION: Efficient, accurate, and robust algorithms are desired for the automatic detection of non-natural curvilinear features in remotely sensed imagery. Such features of Multi-channel Satellite Imagery may have low contrast against noisy highly variable backgrounds. An example would be tracks of enhanced spectral radiance in clouds induced by ships below. Such ship tracks in satellite images at certain spectral bands are apparent to the eye, but an objective automated detection procedure with low false alarm rate is required for operational applications. Conventional linear feature algorithms such as edge detection, matched filtering, or linear Hough transforms may not perform well enough for this problem. Methods utilizing mathematical morphology, neural networks, locally adaptive processes, or other advanced image processing tools may provide the key to a solution.

PHASE I: Provides initial candidate procedures that show greatest promise for further development into full-fledged algorithms. Results of tests using sample images with typical features, such as ship tracks, should be documented in a report. Of particular interest are success rate, false alarm rate, and robustness.

PHASE II: Provide final algorithms, with code adhering to modern programming standards, complete documentation, and a final report detailing results of test cases.

PHASE III: A follow on effort may be desirable, indicating how best to integrate the results of Phase II into the Tactical Environmental Support System (TESS), with full recognition of operational limitations on computer resources and environmental data access. Follow-on effort to be negotiated as a Task under the Office of Naval Technology Space Technology Area Block Program, RL1A.

N93-002 TITLE: Automated Oceanographic Imagery Information

CATEGORY: Exploratory Development

OBJECTIVE: Develop a unified information structure for a system of automated information tools and methodology to provide its output to oceanographic forecast models efficiently.

DESCRIPTION: Satellite sensors are a logical choice to fill the gaps left by conventional oceanographic measurements, due to their capability for synoptic coverage. An oceanographic analysis that depicts the positions and sizes of mesoscale features can be valuable itself, but the benefit is potentially greater when the analysis provides input to a forecast model. An example is the assimilation of a map of front and ring positions along with other information (e.g., thermal gradients, ring rotation rates) into a three-dimensional description of the ocean thermal structure, with the analysis used to initialize a forecast of the upper ocean thermal structure. The forecast may provide data for a subsequent analysis.

PHASE I: Recommendations for integrating a system of automated analysis tools in the most appropriate manner. The Government will provide information on the details of techniques.

PHASE II: Development of a complete, end-to-end system (including assimilation into models) based on the recommendations that result from Phase I, and demonstrating and testing the system on data to be supplied by the Government.

PHASE III: Follow-on effort to be negotiated as a Task under Office of Naval Technology, Stennis Space Center's Environmental Acoustics Technology Area Block Program, (RL3C).

OFFICE OF ADVANCED TECHNOLOGY

N93-003 TITLE: Advanced Systems and Technologies for Future Naval Warfare

CATEGORY: Exploratory/Advanced Development

OBJECTIVE: Enhance Navy's future warfare capabilities for the following top level needs, mine countermeasures, non-cooperative target recognition, ship self defense, cooperative engagement, torpedo defense, sensor technology for counterstealth-aircraft, missiles and ships, battle management, precision standoff strike weapons-munitions multipliers, targeting, bomb damage assessment (BDA), advanced air launched missile technology, reduced cost for munitions/expendables, global surveillance & communications, submarine stealth and affordability, ASW systems for shallow water, manning/training, and manpower utilization.

DESCRIPTION: Navy is seeking new, innovative, high risk/payoff ideas in technologies and or advanced systems concepts that supports the Navy's mission in the years 2000 and beyond. Ideas are required to enhance and solve technology problems detailed in the objective statement.

PHASE I: At the end of the six month effort work should have demonstrated the feasibility of a system concept or technology, identified critical subsystems or technologies that must be matured for transition into the Navy's acquisition system, clearly identified goals for system performance, outlined the state of current technology maturity, provide evidence that the scientific principles on which the proposal was based are sound and justify further work, and identified the work necessary in a phase II effort to demonstrate technical feasibility and increase the potential of the technology or systems concept to transition.

PHASE II: At the end of a two year effort, the technology or systems concept must have been developed enough to bring critical subsystems or technologies for transition to maturity, completed sufficient work to enable the technology to transition to an advanced technology demonstration, or into a higher category RDT&E, or become the basis for a statement of need and acquisition of the technology or systems concept for Navy applications.

PHASE III: A Navy phase III effort is anticipated.

N93-004 Technology for Affordability

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this project is to develop innovative process technology, concurrent engineering or manufacturing processes capable of effecting change in aircraft, ships, boats or components thereof that will be cost effective reliable and maintainable.

DESCRIPTION: At the present time the manufacturing and engineering sectors of the country have been slow to transition new developments into production; typically low volume implies high cost and there is a dependence on low yield production of critical components. As a rule, activities above the factory floor drive costs and there are high maintenance costs associated with new developments. Proposals are sought that will provide innovative developments in manufacturing processes, concurrent engineering and process technology that will effect the Navy and overall industrial production.

PHASE I: Identify improvements and detail where and why they will be effective. A minimum of three awards will be made.

PHASE II: Choose one of those improvements and develop a working model/prototype. Develop a Phase III plan.

PHASE III: Implement the Phase III plan developed in Phase II.

N93-005 Technology Improvement

CATEGORY: Exploratory Development

OBJECTIVE: To gain/regain advantage in technology that the United States does not now possess.

DESCRIPTION: In recent years the United States has either lost its technological advantage in some areas to other countries for one reason or another; or has never had an advantage in particular technologies or products derived from those technologies that are critical to Navy's mission and the nation.

PHASE I: Using the Far East countries as a base, perform a study identifying technologies that should be pursued by the United States that would benefit the Navy and the nation. Identify the reason for the deficiencies, why particular

technology gaps exist, and how those at technologies could benefit the nation. A minimum of three awards will be made in this area for quality proposals.

PHASE II: Establish a demonstration model of an appropriate technology detailed in Phase I and develop a Phase III plan.

PHASE III: Implement the Phase III plan developed in Phase II.

MARINE CORPS SYSTEMS COMMAND

N93-006 TITLE: Laser Discrimination

CATEGORY: Exploratory Development

OBJECTIVE: To develop a device to discriminate between invisible near infrared, far infrared and ultraviolet lasers.

DESCRIPTION: Laser Discriminating Device - Near infra-red (1.06μm) and far infra-red (10.6μm) lasers are routinely used in ranging. Devices are available which can detect these radiations, but there is no reliable method to discriminate between them. For any countermeasure it is desirable to discriminate between them. The Naval Surface Warfare Center (NSWC) has identified materials and has developed a methodology by using this material to discriminate between near infra-red and far infra-red lasers by monitoring the color of the stimulated emission from this material. The color change is quite distinct and is a quick way to determine the wavelength region of incident radiation. This scheme can be further extended to discriminate ultraviolet lasers from the above mentioned lasers by monitoring the temporal profile of the incident lasers.

PHASE I: Phase I requirements include the development of the materials to optimize the emission and the color change of the stimulated emission when irradiated by 1.06μm and 10.6μm lasers. A feasibility study of making a device on this concept is desired.

PHASE II: In Phase II, a working prototype including the ultraviolet discrimination is desired.

PHASE III: Parts of this investigation have commercial applications.

N93-007 TITLE: Multi-Purpose Tactical Antenna

CATEGORY: Exploratory Development

OBJECTIVE: To design and develop a prototype antenna with continuous receive and multi-band transmit capabilities that incorporates miniaturization and other state-of-the-art techniques to accommodate field use.

DESCRIPTION: To meet the requirements of many missions, it is necessary to utilize a variety of tactical radios and receive only equipment in the VHF/UHF spectrum. Current antenna systems are dedicated to specific frequency ranges, do not take advantage of new size reduction technologies, and do not meet tactical visibility requirements. The ability to provide tactical users a multi-purpose antenna capable of meeting a variety of send/receive applications is sought.

PHASE I: Concept exploration resulting in the provision of a feasibility study which outlines technologies or design approaches that could be utilized. Phase I will also include the delivery of a technical proposal which outlines a specific design approach. The design approach will include: a development plan, the specification of manufacturing technologies to be used, and the specification of performance capabilities and trade-offs.

PHASE II: Implementation of Phase I design in the build of two engineering development models capable of being tested in a field environment. Data will be collected to verify performance capabilities and will be provided in a final product evaluation report.

PHASE III: Navy Phase III is anticipated from this topic.

N93-008 TITLE: Receive-Only Radio Equipment

CATEGORY: Exploratory Development

OBJECTIVE: To design and develop a prototype tactical receive only radio with continuous HF/VHF/UHF band capabilities that incorporates modularity, miniaturization and other state-of-the-art techniques to accommodate field use.

DESCRIPTION: To meet the requirements of many missions, it is necessary to utilize a variety of tactical receive only equipment in the HF/VHF/UHF spectrum. Current receivers are dedicated to specific frequency ranges, do not take advantage of new size reduction technologies, and do not meet tactical mobility requirements. The ability to provide tactical users a man-packable, multi-purpose receiver capable of meeting a variety of single channel step, scan, and search applications is sought.

PHASE I: Concept exploration resulting in the provision of a feasibility study which outlines currently available or new capabilities, technologies, or design approaches that could be utilized in an integration effort to provide enhanced capability with a reduction in size. Phase I will also include the delivery of a technical proposal which outlines a specific design approach. The design approach will include a development plan, the specification of manufacturing technologies to be used, and the specification of performance capabilities and trade-offs.

PHASE II: Implementation of Phase I design in the build of two engineering development models capable of being tested in a field environment. Data will be collected to verify performance capabilities and will be provided in a final product evaluation report.

PHASE III: Parts of this investigation may have commercial application.

N93-009 TITLE: Refrigeration for Combat Medical Units

CATEGORY: Exploratory Development

OBJECTIVE: To explore new concepts in providing front line military medical personnel with refrigeration capability.

DESCRIPTION: This solicitation is an attempt to take advantage of lessons learned during the Gulf War and to design and/or conduct comparative testing of available refrigeration techniques suitable under combat conditions.

PHASE I: Concept exploration resulting in the provision of a feasibility study which outlines currently available or new capabilities, technologies, or design approaches that could be utilized to provide suitable refrigeration. Phase I will also include the delivery of a technical proposal which outlines a specific design approach. The design approach will include a development plan, the specification of manufacturing technologies to be used, and the specification of performance capabilities and trade-offs. Characteristics of the Refrigeration for Combat Medical Units must be: (a) Capable of providing temperatures below 30 degrees F. in the freezer compartment and 40 degrees F. in the cooler compartment. (b) Capable of utilizing power supplied by military vehicles, with electrical generators and worldwide utility power as alternatives. (c) Does not use CFC's. (d) Does not use traditional compressors to compress gases.

PHASE II: Implementation of Phase I design in the build of two engineering development models capable of being tested in a field environment. Data will be collected to verify performance capabilities and will be provided in a final product evaluation report. If a working prototype is provided at Phase I, the scope of this effort would be expanded.

COMMERCIAL POTENTIAL: Exists in the medical industry and food industry.

N93-010 TITLE: Miniature Electrical Generators

CATEGORY: Exploratory Development

OBJECTIVE: To explore new concepts in providing combat military personnel with electrical generation capability.

DESCRIPTION: This solicitation is an attempt to take advantage of lessons learned during the Gulf War and to design and/or conduct comparative testing of available generators that would be suitable under combat conditions.

PHASE I: Concept exploration resulting in the provision of a feasibility study which outlines currently available or new capabilities, technologies, or design approaches that could be utilized to provide enhanced capability with a reduction in size, weight, and noise. Phase I will also include the delivery of a technical proposal which outlines a specific design approach. The design approach will include a development plan, the specification of manufacturing technologies to be used, and the specification of performance capabilities and trade-offs.

Characteristics of the Miniature Electrical Generators must be:

Provide 0.5 KW output at 110-120 Volts.

Lighter in weight than comparable commercial generators.

Operate under full load at a noise level (db) measurably below comparable commercial generators.

PHASE II: Implementation of Phase I design in the build of two engineering development models capable of being tested in a field environment. Data will be collected to verify performance capabilities and will be provided in a final product

evaluation report. If a working prototype is provided at Phase I, the scope of this effort would be expanded.

PHASE III: Navy Phase III is anticipated from this topic.

N93-011 TITLE: Advanced Weapons Material: Exterior Surface

CATEGORY: Exploratory Development

OBJECTIVE: To design and develop prototype/proof of concept demonstrators for advanced material alternatives for the exterior of various weapons components which stops or significantly deters environmental effects to include saltwater.

DESCRIPTION: Material alternatives should be able to be durably or permanently bonded to the primary weapon component material. If the candidate material is useful as the primary material or as the interior coating, then that would be considered an enhancement. Adverse environmental effects degrade weapons readiness and cause additional cleaning and maintenance requirements. Primary environmental concerns are the effects of water, salt and sand. Other enhancements would be if the candidate material improved component strength and contributed to improved thermal management.

PHASE I: Concept exploration resulting in the provision of a feasibility study which outlines currently available or new technologies, capabilities, or design approaches that could be utilized in an integration and/or fabrication of systems possessing the above described attributes. Phase I will also include the delivery of a technical proposal which outlines a specific design approach. The design approach will include: a development plan, the specification of manufacturing technologies to be used, and the specification of performance capabilities and trade-offs.

PHASE II: Implementation of Phase I design in the building of two proof of concept/technology demonstrators capable of being tested in a field or range environment. Data will be collected to verify performance capabilities and will be provided in a final system evaluation report. The final system evaluation report will additionally include recommendations addressing noted deficiencies and for improving performance.

PHASE III: Navy Phase III is anticipated from this topic.

N93-012 TITLE: Advanced Weapons Material: Interior Surface.

CATEGORY: Exploratory Development

OBJECTIVE: To design and develop prototype/proof of concept demonstrators for advanced material alternatives for the interior of various weapons components which significantly improves thermal management, deters environmental effects to include saltwater, and the adverse effects of interior ballistics.

DESCRIPTION: Material alternatives should be able to be durably or permanently bonded to the primary weapon component material. If the candidate material is useful as the primary material or as the exterior coating, then that would be considered an enhancement. Adverse thermal, environmental and interior ballistic effects degrade weapons readiness and cause additional cleaning, maintenance and logistic requirements. Primary environmental concerns are the effects of water, salt and sand. It would be considered an enhancement if the candidate material improved component strength. The primary focus of the effort should be the improvement of thermal management.

PHASE I: Concept exploration resulting in the provision of a feasibility study which outlines currently available or new technologies, capabilities, or design approaches that could be utilized in an integration and/or fabrication of systems possessing the above described attributes. Phase I will also include the delivery of a technical proposal which outlines a specific design approach. The design approach will include: a development plan, the specification of manufacturing technologies to be used, and the specification of performance capabilities and trade-offs.

PHASE II: Implementation of Phase I design in the building of two proof of concept/technology demonstrators capable of being tested in a field or range environment. Data will be collected to verify performance capabilities and will be provided in a final system evaluation report. The final system evaluation report will additionally include recommendations addressing noted deficiencies and for improving performance.

PHASE III: Navy Phase III is anticipated from this topic.

N93-013 TITLE: Target Acquisition & Fire Control Solution

CATEGORY: Exploratory Development

OBJECTIVE: To design and develop prototype/proof of concept demonstrators for advanced target acquisition, identification, engagement and full solution fire control. Order of magnitude advances desired to compliment conventional and future weapons for engagements at 3000m plus range.

DESCRIPTION: System performance should approach suitability for line-of-sight/line-of-fire weapon systems at effective engagement ranges of 3000m, (2) should permit rapid target acquisition out to 6000m, (3) should provide for target identification, (4) should track the target during mutual movement for some applications, and (5) provide full solution fire control at least one kilometer prior to the respective engagement ranges. Application can be for individual, crew served or vehicle mounted weapon systems; small to medium caliber and rocket-fired direct fire weapons. Reductions in weight and size required. Potential desired for improved durability, reliability and maintainability.

PHASE I: Concept exploration resulting in the provision of a feasibility study which outlines currently available or new technologies, capabilities, or design approaches that could be utilized in an integration and/or fabrication of systems possessing the above described attributes. Phase I will also include the delivery of a technical proposal which outlines a specific design approach. The design approach will include: a development plan, the specification of manufacturing technologies to be used, and the specification of performance capabilities and trade-offs.

PHASE II: Implementation of Phase I design in the building of two proof of concept/technology demonstrators capable of being tested in a field or range environment. Data will be collected to verify performance capabilities and will be provided in a final system evaluation report. The final system evaluation report will additionally include recommendations addressing noted deficiencies and for improving performance.

N93-014 TITLE: Countermine Multisensor Fusion Detection Device

CATEGORY: Exploratory Development

OBJECTIVE: To design and develop Mine/ Countermine Detection Systems which apply Neural Networks to Multisensor fusion in detecting and classifying worldwide mine types both surface and buried.

DESCRIPTION: This solicitation attempts to take advantage of Neural Network technology related to multisensor fusion in properly combining Infra-Red sensor, Ground penetrating radar, and explosive "sniffers" for mine detection and classification. The envisioned concepts may replace classical mine detection devices and concurrently provide a system that is as easily attached to the Unmanned Ground Vehicle (UGV) and can significantly contribute to the assault breaching of minefields. Exclusive of the hand-held mine detectors, (and Marines with bayonets), devices to detect mines have been extremely limited in their ability to detect all mine types; especially when buried. The advantages of combining multiple sensors are: an increased ability to detect all mine types and a drastic reduction/elimination of "false alarms". The primary mission of the Countermine Multisensor Fusion Detection Device is Mine detection and classification. It's secondary capability would be the remote identification of mines / minefields because such secondary capability is easily incorporated into the UGV which utilizes Forward Looking Infra-Red (FLIR) and Optical sensors, and Teleremoting operations.

PHASE I: Phase I would consist of concept exploration resulting in a feasibility study, review of current documentation, and a preliminary design study which produces a System Concept Document (SCD), or equivalent. The SCD or equivalent must describe the proposed hardware design to include materials, proposed sensor suite, multisensor fusion strategy, neural network programming, mine/ countermine detection techniques, tactical employment, storage and use, flexibility, size and weight estimates.

PHASE II: Phase II would consist of preparation of detailed design drawings and assembly of the prototype devices. Prototype design will be verified by mine detection/ classification testing for effectiveness against simulated threat minefields.

PHASE III: Some parts of this investigation may have commercial use.

N93-015 TITLE: Real-Time Image Fusion

CATEGORY: Advanced Development

OBJECTIVE: To combine imagery generated by both intensified TV and thermal-imaging night vision systems, thereby exploiting a greater portion of the electromagnetic spectrum and simultaneously maximizing content on a single display.

DESCRIPTION: A need exists to provide a mechanism to produce both intensified TV and thermal imaging night vision system on a single display.

PHASE I: Phase I will determine the technical feasibility of combining the best attributes of any two TV and thermal-imaging night-vision systems into a single image. The study will determine, at a minimum, whether the combined imagery will allow the operator to see into shadows, see subtle thermal variations in the scene, see low light emissions and reflections, while retaining individual detail from each sensor. It is expected that the study will spawn an engineering prototype (in the form of a circuit card) as an item deliverable, complete with detailed laboratory test and evaluation data.

PHASE II: Phase II will generate a "black box" encapsulating the prototype circuit card, free from any imperfections identified in Phase I. The "black box" should have 3 total video ports: one input port for thermal-imaging video, one input port for TV video, and one output port to "hand-off" the combined imagery. The "black box" must also compensate for variances in the thermal imaging and TV system fields-of-view and thereby permit a high-resolution image merger between any two given systems. Naval Surface Warfare Center (NAVSURFWARCENDIV Crane) Night Vision & Electro-Optics will conduct a thorough independent evaluation to determine the merits and effectiveness of the "black box".

PHASE III: Navy Phase III is anticipated from this topic.

N93-016 TITLE: Command Communications System Interface for Amphibious and Land Combat Vehicles

CATEGORY: Exploratory Development

OBJECTIVE: To explore innovative approaches to implementing lightweight, combat survivable communications control in military vehicles.

DESCRIPTION: Current communications control systems are limited by dated technology. Significant improvements in time, covertness and capability are possible if new products can be effectively used in the combat environment. The current system in the AAVC7A1 controls six (6) transceivers and five (5) receivers and provides a multifunction intercom system. The system is accessed by ten (10) user stations with each station having preprogrammed access to two (2) radio assets. Any proposed replacement must be based on current fiber-optic Local Area Network technology allowing the following options:

16 users (Maximum) each having both voice and digital terminal inputs (32 inputs)
Individual user access to 32 radio assets (Maximum)
Intercom able to provide one to one, one to many or one to all contacts
User friendly, fault tolerant
Able to fit into LAV, BFV, and AAVC7A1
Able to operate from unregulated 18-32 volt DC power
Draw less than the current MSQ-115 system on the AAVC7A1
Provide Tempest security

PHASE I: During the Phase I effort the contractor should provide a number of approaches that are possible solutions to the problem. The proposals should be of sufficient detail to allow for government review and selection for Phase II implementation.

PHASE II: During the Phase II effort the contractor should provide a detailed design of two approaches from Phase I with installation and demonstration on an AAVC7A1. The successful approach shall be documented for future installations or production.

PHASE III: If the Phase II is successful, it is anticipated that such an approach will have immediate benefit for AAV and likely other combat vehicle platforms. Additionally, techniques developed under this study will have transferability to the commercial area.

N93-017 TITLE: All-Consumable Ration Pack

CATEGORY: Exploratory Development

OBJECTIVE: To design and develop a menu of ration packs which are appealing, nutritionally healthful, durably contained or processed and wholly consumable to include any required containment medium. The term "containment medium or process"

is used so as not to dictate technology or design approach. This "medium" may be separate and distinct from the substance of the ration as in traditional packaging or indistinguishable from the substance of the ration as may be developed through chemical and/or physical process.

DESCRIPTION: Marine Reconnaissance teams carry a combat load of 90 to 120 pounds per man to include weapons and ammunition, water ,food, optics, communications equipment, and other mission essential gear. Food is the first item to be left behind. When it is carried, a seemingly innocuous U.S. military ration wrapper inadvertently left along a patrol route could compromise the clandestine nature of an operation if detected by counter reconnaissance.

There exists a requirement for a ration pack that is completely consumable to include any required containment medium. Though desired, it is not required that the containment medium itself have nutritional value. The ration would be resistant to water, heat, cold, and other environmental effects. It would be of high caloric density, preferably with a day's nutrition contained in one or two meals. A variety of complete menu selections will eventually be developed. Nutritional value and caloric density of the objective meals shall be equal to or greater than that of the current combat rations. Weight and bulk shall be less than that of the current combat rations. The meals shall require no preparation prior to consumption. Because of the monumental logistic burden just to handle and dispose of combat ration packaging for operating forces at large, it is anticipated that All-Consumable Ration Pack technology may eventually be applied to all military rations.

PHASE I: Phase I would consist of concept exploration and feasibility study, selection of approach and process followed by the design and production of prototype menu items.

PHASE II: Phase II would encompass nutritional analysis and certification that developmental articles are safe to test. Production of test articles will be followed by technical and operational testing to include environmental durability and food preservation, long- and short-term depot and shipboard storage, field storage and consumption.

PHASE III: This product would readily lend itself to commercialization not only to limited uses such as outdoor and survival outfitters and space industry in parallel application but also to the entire food and food processing and packaging industry. Technology advancement would likely gain strong support from environmental interest groups.

SPACE AND NAVAL WARFARE SYSTEMS COMMAND

N93-018 TITLE: Constraints and System Primitives in Achieving Multilevel Security in Real time Distributed Systems Environments

CATEGORY: Research

OBJECTIVE: Study trusted distributed systems which operate over a heterogeneous collection of processors.

DESCRIPTION: This effort should produce a preliminary design for a distributed operating system and develop an initial proof-of-concept prototype to investigate the principal mechanisms that support distributed operating systems. Central to this research effort is the examination of the network server interaction locally and across the network. Issues of object name space, user and machine identification and authentication, exploitable covert channels, and configuration control should be addressed. A design for audit across the distributed system should be developed. Issues associated with strategies for data replication and remote node authentication within the distributed system should also be considered.

PHASE I: Conduct analysis of trusted distributed systems which operate over a heterogeneous collection of processors.

PHASE II: Produce a preliminary design for a distributed operating system based on the analysis of Phase I.

PHASE III: Implement a distributed operating system as a proof-of-concept prototype to provide the basis for industry to produce and offer MLS Real Time Distributed Operating Systems for use in Navy and DOD mission critical systems.

N93-019 TITLE: Tactical Data Transfer Protocol Accelerator

CATEGORY: Exploratory Development

OBJECTIVE: Develop and prototype the hardware and software needed to process data transfer protocols at the Network and Transport Layers in high performance local area networks.

DESCRIPTION: Develop a means to accelerate the processing of tactical (i.e., real-time) protocols at the network and Transport layers in order to provide a data transfer service at the Transport-Session layer boundary that runs at the speed of the underlying

media. The principal media of interest is the 100 Megabyte per second or better SAFENET Lightweight Suite Local Area Networks.

PHASE I: Phase I efforts will prepare a detailed design which will include the plan for incorporating the hardware and software developed in Phase II into a scientific workstation. the Phase I proposals should address how the key tactical features of the transfer protocol are to be accelerated. The key tactical features south are: Prioritized message transfer, acknowledged multicast and selectable error control.

PHASE II: Develop engineer develop models with the resulting software and hardware integrated into a scientific workstation.

PHASE III: Anticipated future use in high speed Navy shipboard networks.

COMMERCIAL POTENTIAL: Exists for technical workstations and file servers.

N93-020 TITLE: Multi-Network Engineering Tool

CATEGORY: Exploratory development

OBJECTIVE: To develop a software tool to aid network engineers in the planning of the system topology, the equipment selection and the performance engineering of multi-network systems.

DESCRIPTION: The adoption of Fiber Distributed Data Interface (FDDI) as a U.S. Navy standard SAFENET II presents a new challenge to network engineers. The FDDI standard is well suited to small networks of 10 closely spaced stations or less. However, there are requirements for the internetting of larger land based facilities and larger ships, such as aircraft carriers, where the notion of one large network is being replaced by the concept of several interconnected small ones. Presently, a software tool is under development, through SBIR, to engineer the performance of single SAFENET II/FDDI networks. A multi-network system will require engineering in 3 specific areas: 1) specification of the optimum system topology; 2) selection of optimum hardware configurations to compliment the topology; and 3) engineering of overall system performance.

PHASE I: This phase should provide a methodology and a tool design for the specification of a system topology, selection of hardware configuration and the engineering of system performance.

PHASE II: This phase should provide a demonstratable software tool that implements the elements of Phase I.

PHASE III: Strong candidate users of this tool are the NTCS-A, OSS, NGCR and Copernicus programs.

N93-021 TITLE: Critical-Time/Real-Time Database Management

CATEGORY: Research

OBJECTIVE: Develop critical-time/real-time database management capabilities that will provide the performance improvement demanded by mission critical applications with stringent processing/response requirements.

DESCRIPTION: The data requirements of mission critical Navy systems have been increasing dramatically, Navy C3I systems must mange land, sea, airborne and space data elements. Driving such systems are significant requirements for maintenance of thousands of objects, discriminating the real threats among them, and tracking them with real-time updates. Tactical weapons systems require performance in the highly real-time to critical-time performance envelopes. Autonomous sensor/weapon control systems must deal with an enormous quantity of unfiltered data coming in at very high data rates. Critical to success of mission critical Navy systems is the ability to mange large (gigabit) databases in a fast, predictable and reliable manner. The demanding mission critical environment will become even more challenging due to a substantial increase in the amount of data to be considered as a result of new sensor systems and communications capabilities, and reduced reaction time resulting from increasingly sophisticated weapons that can minimize detection time. Response to critical-time/real-time requirements for large databases is beyond the capability of currently available Database Management Systems (DBMSs). Such DBMSs lack an awareness of, and the ability to, meet the deadline and/or time-critical nature of the processing requirements. Additionally, currently available DBMSs are not able to offer the high throughput rates required by Navy systems. Existing Navy systems utilize a significant level of hand tailored assembly level code to meet these types of performance requirements.

PHASE I: Identify research needed to develop the technology to permit database management systems to support the Navy's critical-time/real-time data management requirements.

PHASE II: Implement the research identified under Phase I.

PHASE III: Expected the results of this research will be incorporated into the Navy Commands' Systems and other

systems that require real-time DBMS.

N93-022 TITLE: Composibility Constraints of Multilevel Systems

CATEGORY: Research

OBJECTIVE: Research into techniques for achieving verifiable security levels when aggregating and integrating trusted elements, components, and sub-components.

DESCRIPTION: Current Information Security (INFOSEC) systems are networks of interconnected processing elements and databases connected to devices which allow human operators to interface with the data and computing resources. The concept of Trusted Computer Base (TCB) was initiated when computer systems were basically monolithic systems consisting of a mainframe or host computer which interfaced to the user by directly connected unintelligent terminals. These terminals had a unique I/O port or were multiplexed to a single port in such a way that the host computer terminal or group of terminals it was talking to by knowing the physical prot to which the terminals were connected. Present computer systems are networks constructed with many processing elements which may or may not include a host computer. Local Area Networks (LANs) have replace the direct connections. this effort should address the issues/constraints associated with developing trusted systems through the combination and integration of trusted components such as trusted operating systems, trusted Database Management Systems (DBMSs), and secure LANs. A composibility model is to be developed which will allow an evaluation of the security properties of a combination of trusted components whose individual security properties have been evaluated separately.

PHASE I: Analyze issues/constraints in systems development associated with combining trusted components.

PHASE II: Design a set of test cases as a proof-of-concept of the approach developed in Phase I. Demonstrate, through simulation, the effect of combining trusted components in the system development process.

PHASE III: Industry would use the results of Phase II to develop products and tools to help Navy and other system developers to produce MLS Mission Critical Computer Based Systems.

N93-023 TITLE: New Electronic Warfare (EW) Identification (ID) Techniques

CATEGORY: Exploratory Development

OBJECTIVE: The objective is to develop and demonstrate a technique which will identify a single radio frequency emission to one certain weapon platform (emitter) - without alternatives or ambiguities.

DESCRIPTION: High quality radar and other emitter identification is a fundamental requirement for surface electronic warfare systems. Current EW warning systems have ID performance limitations and do not provide high confidence and unambiguous emitter ID.

PHASE I: The basic thrust of the Phase I development is to investigate and technically demonstrate an improved or new EW identification technique, which will solve key and current emitter ID ambiguity problems. The basic goal is to get unique emitter ID performance - no ambiguities. The Phase I development shall include the development of the new ID technique, theoretical or technical analysis and technical considerations related to and supporting the approach, and actual ID performance results using real world emitter signals and a final report summarizing the development.

PHASE II: Potential Phase II developments will include preliminary ID system design and integration into a surface EW system, and critical technological feasibility demonstrations, which are associated with the new EW ID technique.

PHASE III: Transition to Phase III will focus on surface ship self defense such as applications for the SLQ-32 or SLQ-54 upgrades, and applying the results of Phase II. Phase III will not be limited to surface warfare but provide for growth to aircraft self-defense, such as ALQ-109.

N93-024 TITLE: Inter-Service Voice Communications Model

CATEGORY: Advanced Development

OBJECTIVE: Develop a model of voice communications processes for applications in interactive simulation systems which focus on joint force operations

DESCRIPTION: Large scale simulations currently in use to support research and development of command, control, and communications systems do not incorporate realistic models of voice communications use in joint warfare operations. A new model should be capable of simulating voice communications connectivity line-of-sight requirements, electromagnetic interference, jamming, circuit loading, crypto synchronization, and similar factors. Development of such a model for use with interactive simulation systems is desired to allow more realistic modeling of the joint C_3 environment so that system effectiveness can be more accurately estimated.

PHASE I: Should define a model concept and provide a detailed description of the model, including any hardware required for digitization or other requirements.

PHASE II: Should provide the software, hardware, and procedures to provide a complete working model.

PHASE III: The voice communications model would be implemented in the Research, Evaluation, and Systems Analysis (RESA) simulation system in a multi-service, multi-warfare exercise. The exercise would be designed to stress C_3 in an approved JCS scenario. Other potential users and implementations could be explored, including FAA applications, Emergency Management C_2, and local law enforcement C_2.

N93-025 TITLE: Virtual Information Transfer Emulator (VITE)

CATEGORY: Engineering Development

OBJECTIVE: The objective is to test and adapt emerging video and model-modifying techniques to optimize data/video hybrid replication transfer over existing land and satellite links to and from Fleet units.

DESCRIPTION: As telecommunication bandwidths increase, either from allocation or virtually by data compression or improved protocols and management, it is predictable that the input information volume will increase. For many years a totally global link bandwidth will be limited by landline or ship cabling characteristics. This task will develop a prototype system optimizing an amalgam of commercial video formats and protocol, Defense Mapping Agency derived models with zooming capability from Battle Group to ownship area, and movable windows with video and data panes in Ada, I-CASE environment. The fundamental updates of previously modelled data or video/audio scenes. This schema would enable short, quick packages of data in real time or "quick batch" to reduce overall traffic demands and use low point to point bandwidth. It is anticipated that this approach will become a "force multiplier" for more advanced data links in the future.

PHASE I: Trade-off analysis of existing or low risk emerging techniques. Insertion of higher risk techniques with innovative risk reducers for optimizing payoff. A short loop demonstration using PC to PC remote connection, CD-ROM resident scenarios (30 to 60 minutes) with externally selected naval engagement overlays. Proposer may offer an alternate means of demonstration.

PHASE II: Implement a sender-to-user workstation environment based on the model(s) designed in Phase I for an initial evaluation at a Navy facility such as the Naval Command Control and Ocean Surveillance Center (NCCOSC).

PHASE III: A Navy Phase III effort is anticipated.

N93-026 TITLE: HF Emulator for Adaptive Reception (HEAR)

CATEGORY: Engineering Development

OBJECTIVE: The objective is to test and adapt commercially available expert and phoneme based techniques to sharply reduce or eliminate operator requirements for HF communications links to and from Fleet units.

DESCRIPTION: Despite major improvements to HF communications reliability such as forward error correction, automatic link establishment and link quality analysis, HF systems bear the stigma of operator intensity. These are vital links to and among Fleet units as backup and alternative paths. This task develops the notion that a communications operator is not required and envisions the standard Navy console operator or non-console CIC evaluator literally calling up his desired connectivity by voice actuated commands.

PHASE I: Trade-off analysis of existing or low risk emerging techniques. Demonstrate the design at the PC to PC workstation level, assuming bit error rates now achievable with adaptive modems, illustrating networking adaptive routing possibilities in response to voice managed data streams at 1200 baud rates.

PHASE II: Implement the Phase I design in prototypes of transmitter and receive modifiers within a network emulation for test and evaluation at a Navy facility such as the Naval Command Control and Ocean Surveillance Center (NCCOSC).

Software products from this stage must be transportable to an Ada, I-CASE environment.

PHASE III: A Navy Phase III effort is anticipated.

N93-027 TITLE: Satellite Communications (SATCOM) Multi-Band Antennas

CATEGORY: Exploratory Development

OBJECTIVE: Develop smaller, lighter, higher performance SATCOM antenna (systems) operable across multiple frequency bands.

DESCRIPTION: To establish SATCOM connectivity in each frequency band (military UHF, SHF, and EHF and commercial (C, Ku, L, etc.)) the Navy must currently operate from separate antennas (systems). In order to minimize the topside space and weight required to install SATCOM antenna (systems) for operational use on Navy ships, methods are sought to combine operations of multiple frequency bands (two or more) on single antenna systems. This will allow increased channel bandwidth capacity in support of the Copernicus architecture.

PHASE I: Feasibility studies shall be presented which address the potential performance of antenna array(s) that operate over a minimum of two (or more) frequency bands that will satisfy current and future operational needs on a wide variety of Navy shipboard platforms. Higher transmission rates to be addressed shall include but not be limited to: UHF up to 64 ksps, SHF up to 2 X T1 (symbol rate), and EHF up to 2 X T1 (symbol rate) and commercial up to 2 X T1 (symbol rate). The studies shall consider the possibility of using existing pedestals and control mechanisms as a cost savings.

PHASE II: Develop the antenna system(s) defined in Phase I and provide models for potential shipboard testing and evaluation of the proposed improvements.

PHASE III: SATCOM project funds are available to support a Phase III effort, a multi-frequency band antenna.

N93-028 TITLE: Flexible Bit Rate Voice

CATEGORY: Engineering Development

OBJECTIVE: Develop a flexible digital voice capability that permits fleet users to tailor call requirements (e.g., intelligibility) and commensurate voice bandwidth to the limited capacity communication links available between ship-ship and ship-shore.

DESCRIPTION: Naval voice communication requirements can be satisfied by sing a variety of vocoding techniques that provide minimum acceptable intelligibility to near toll quality speech. Similarly, Navy Communication link capacities available for voice use can vary dramatically depending on platform type, location, and tempo of operations. A flexible-bit-rate voice capability would permit users to match their call requirements (e.g., intelligibility, privacy, etc.) to available communication capacity.

PHASE I: Define the functional requirements and propose a top level design of a flexible-bit-rate voice capability.

PHASE II: Develop two prototype flexible-bit-rate voice units and complete laboratory back-to-back testing. Document the design and test within a final report.

PHASE III: Develop two prototype flexible-bit-rate voice capability within next generation Navy communication systems.

N93-029 TITLE: Broadband Submarine Communications Mast Antenna

CATEGORY: Research

OBJECTIVE: Develop a submarine RF mast antenna system which provides SSN and SSBN submarines with Copernicus compatible communications.

DESCRIPTION: Develop submarine RF mast antenna system concepts that provide broadband, multiple link, multiple frequency, variable data rate, transceive capability to support future Copernicus requirements.

PHASE I: Shall address concept designs, RF and operational performance, and trade-off studies.

PHASE II: Will include test and evaluation to demonstrate feasibility of the concepts.

PHASE III: Anticipate Navy sponsorship to transition into the Submarine Integrated Antenna System Project.

N93-030 TITLE: Submarine RF Communications Antenna

CATEGORY: Research

OBJECTIVE: Develop a submarine RF antenna for the SSN buoyant cable and towed buoy systems which allow SSN and SSBN submarines to operate and communicate at operational speeds and depths.

DESCRIPTION: Develop submarine RF antenna concepts that provide antennas and towed buoy auxiliary wire antennas with broadband, multiple link, multiple frequency, variable data rate, transceive capability to support future Copernicus requirements. The antennas shall also provide GPS and radar signal reception.

PHASE I: Shall address concept designs, RF, hydrodynamic and operational performance, and trade-off studies.
PHASE II: Will include test and evaluation to demonstrate feasibility of the concepts.
PHASE III: Anticipate Navy sponsorship to transition into the Submarine Integrated Antenna System Project.

N93-031 TITLE: Development of a Planar Lens or Reflector for a Multiple-Beam Multi-Mission Broadband Antenna (MMBA)

CATEGORY: Exploratory Development

OBJECTIVE: Determine the feasibility and complexity involved with the development of a parallel plate planar lens or reflector to form the azimuth beam for the MMBA.

DESCRIPTION: Antennas for special purpose or single system data links are proliferating aboard ships where weight, moment, space and electromagnetic interference are critical considerations. A single antenna satisfying requirements for multiple data links between aircraft and ships is needed. A MMBA will provide connectivity to more than one aircraft simultaneously. A MMBA must ultimately satisfy the following requirements:

* Bandwidth
  - Frequency Coverage: 8 GHZ - 16 GHZ
  - Instantaneous transmit bandwidth: <300 Mhz

* Transmit Power
  - +70 dbm effective isotropic radiated power per link, average

* Receive Gain
  - Equivalent to a 1-meter dish over above frequencies.

* Sidelobe Levels
  - Less than -20 Db relative to main beam peak on transmit

* Azimuth Coverage
  - 360 degrees - Limited antenna location and resultant shadowing will require two or more antennas

* Elevation Coverage
  - -5 to +50 degrees relative to the horizon, with compensation for ship's motion (see Environment)

* Polarization
  - Right Hand Circular

* Environment
  - Compatible with CV/CVN shipboard environment
  - Compensation for following ship motion (+ deg Roll, +1 deg Pitch)

PHASE I: At the end of six months provide a report on the results of investigations of technologies and/or techniques which could be used to provide the planar lens or reflector design to meet the performance parameters outlined in the above

DESCRIPTION section. The report should include a proposed course of investigation for Phase II.

PHASE II: At the end of two years provide analytical and/or experimental verification that technologies/ techniques recommended at the end of Phase I are feasible and affordable to justify initiation and funding of an Advanced and/or Engineering Development project.

PHASE III: Anticipated application under Navy sponsorship.

N93-032 TITLE: Artificial Intelligence Tools for EHF SATCOM Management

CATEGORY: Exploratory Development

OBJECTIVE: Investigate the application of artificial intelligence to the management of EHF SATCOM communications.

DESCRIPTION: To establish an Extremely High Frequency (EHF) Satellite Communications (SATCOM) network, the communications planner must consider a large number of complex factors including network precedence, throughput requirements, available satellite resources, uplink and downlink beam configurations and earth terminal locations and capabilities. Artificial Intelligence (AI) tools are sought to aid the communications planner in planning, establishing and managing EHF SATCOM network connectivity. The AI tools should overlay and enhance existing Navy tactical communications planning tools and procedures and must be compatible with the communications management concepts of the Copernicus architecture.

PHASE I: Define a set of artificial intelligence tools to enhanced EHF SATCOM management.

PHASE II: Develop the AI tools defined in Phase I and demonstrate their operation in the Naval Research and Development Center (Nrad) Communication Support System (CSS) test facility.

PHASE III: EHF IXS project funds have been programmed to support a Phase III effort.

N93-033 TITLE: Data Structures and Architectures for Automated Image Interpretation

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this effort is to develop representations of oceanographic satellite imagery which permit efficient automated analysis and interpretation of scene content.

DESCRIPTION: Oceanographic satellite imagery is used to support many Naval operations. Satellite imagery, by its capability for synoptic coverage of large areas of the ocean, is an important complement to traditional techniques for observing significant features in the world's oceans. Present image interpretive methods are largely manual and are highly subjective. Conventional image processing methods are not especially desirable for this task. new approaches and innovative ideas are needed to represent satellite imagery using data structures of software architectures that facilitate storage, transmission, processing throughput, and accuracy of automated analysis results. Symbolic, statistical, object oriented representations or other parameterizations are sought. Practical representations of oceanographic satellite imagery and representations of the mesoscale information content derived from such images, including the formation and time evolution of the features are sought.

PHASE I: This six month effort should produce an evaluation of data structures or software architectures in support of automated image interpretation.

PHASE II: A two year effort to complete development or structures or architectures to perform feature detection and other automated image interpretation functions.

PHASE III: A Navy Phase III effort is planned.

N93-034 TITLE: Multi Sensor Data Visualization of Meteorological Features

CATEGORY: Exploratory Development

OBJECTIVE: To develop a method for fusing multi-sensor data in order to identify important meteorological features and data visualization methods to clearly and efficiently present the outputs of the data fusion.

DESCRIPTION: New sensors and weapons such as the AEGIS radar system, Tomahawk cruise missiles and precision guided munitions can be severely affected by changing meteorological conditions. Recent advances in sensor technology, particularly

satellite based remote sensing, and numerical modeling techniques have increased tremendously the amount of meteorological information that is available to fleet users. New data visualizations methods are needed to allow quick, efficient interpretation of meteorological conditions affecting weapons and sensors performance.

PHASE I: This six month effort should provide recommendations of innovative methods for the fusion of multiple meteorological data sources and 2-D and 3-D data visualization methods.

PHASE II: A two year effort to demonstrate the use of the recommended advanced data fusion and data visualization methods to identify meteorological or oceanographic features.

PHASE III: A Navy Phase III effort is planned

N93-035 TITLE: Environmental Data Base Compression

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this effort is to develop and test a data base compression capability which will be suitable for fleet use with newly developed computer systems hardware and software.

DESCRIPTION: Environmental data is of four major types: imagery, floating point, binary and ASCII. Applications processes used in environmental systems may make use of any or all of these types of data at any given time. Data Compression technology which facilitates data base communication between a variety of different computer systems spread across thousands of kilometers and, at the same time, facilitates the selection of elements of the entire data base given selected attributes is urgently needed to support ne wand higher technology weapons platforms and sensor systems as well as super computer models.

PHASE I: Trade-off analysis of existing or modified data base compression technology adapted to environmental data.

PHASE II: Completed development of data base compression technology for support of environmental communications.

PHASE III: A Navy Phase III effort is planned

N93-036 TITLE: Machine-assisted Submarine Passive Acoustic Classification

CATEGORY: Advanced Development

OBJECTIVE: Develop a machine-assisted ASW passive classification system

DESCRIPTION: Machine assisted anti-submarine warfare passive classification systems have seldom produced the spectacular results which had been promised because real experts in classification have not built up the classification data base and procedures used in these systems. In this task, it is desired that experts in submarine classification build a data base and set of rules which will help operators improve their ability to classify submarines, with primary emphasis on distinguishing submarines from anything else.

PHASE I: Phase I of this effort shall compile but not demonstrate algorithms and data bases which will classify submarines, based on the experience of experts.

PHASE II: Phase II shall code the classification algorithms generated in Phase I in an interactive computer system and demonstrate the classification capability in real time with recordings of signals from actual submarine encounters. Each phase shall require an initial brief including program objectives, actions and a milestone review; a final review and brief; and a final report. Phase I should report on feasibility, anticipated cost and estimated performance level achieved by the method. An outline of a Phase II demonstration of concept should be included. Phase II should demonstrate a proof of concept system.

PHASE III: It is anticipated that successful Phase II contractors will transfer their technology into the Surveillance Direction System Research and Development program or the Integrated Undersea Surveillance System at the sensor system level. Transition: Surveillance Direction System

N93-037 TITLE: Adaptive Processing for Shallow Water Low Frequency Active Operations (LFA)

CATEGORY: Advanced Development

OBJECTIVE: Develop and test at sea effective monostatic and bi-static adaptive processing techniques for shallow water LFA

operations

DESCRIPTION: Shallow water anti-submarine warfare operation is an increasingly important objective. Bottom reverberation is an extremely complex phenomenon owing to the diversity of ocean floor types, lateral inhomogeneity, and potential contribution of subbottom layers. The received backscattered return is typically a composite process with two or more reverberation types contributing at any given instant. This is especially true in shallow-water environments. In this context, the spatial correlation characteristics of various reverberation components are critically important. The shallow-water environment creates some unique difficulties. As opposed to deep-water settings where the acoustic paths are few and identifiable, shallow-water reverberation returns arrive in rapid succession, imposing stringent adaptation requirements on the adaptive filter and complicating the performance evaluation process. Acoustic reverberation often limits the performance of active sonar systems and spatial reverberation cancellation is required to achieve adequate performance. Reverberation is a particularly difficult source of interference owing to its transient nature, wide dynamic range, and highly uncorrelated properties. Adaptive beamforming techniques offer the potential for reverberation suppression, typically employing an adaptive estimator in conjunction with directional constraints to ensure signal preservation.

PHASE III: Potential Phase III transition opportunities are SURTASS, SQQ-89, and Advanced Deployable Systems

N93-038 TITLE: Coherent Processing for LOFARGRAMS

CATEGORY: Exploratory Development

OBJECTIVE: Develop, demonstrate, test, and evaluate for automatic LOFAR detection a coherent algorithmic processing chain with long time constant integration and determine the Receiver Operating Characteristics (ROC) curves for each integration period.

DESCRIPTION: The task is to develop, demonstrate, and measure the algorithms/techniques required to automatically extract stable signal information from a LOFARGRAM using 15, 30, 60, and 120 minute signal integration times and modify the original time series data for operator classification by a conventional resolution LOFARGRAM data presentation (no new training for the operator). Removal of clutter, interference, biologies, and profiler activity. Methods to reduce or identify processing artifacts to the classification operator are required. The measure of algorithmic performance include probability of detection, probability of false alarm, and recognition differential over the four required observation periods. Proper spectral preparation of the time series data in frequency time format is required with attention paid to both frequency and time redundancy of the presented data. Real (from the Full Spectrum Database) and simulated data will be supplied by the Navy for demonstrations and testing. A specific algorithmic processing chain from respondents is desired with the chain's estimated performance.

PHASE I: Develop as required and implement on a computer critical applications for testing with real (provided by the Navy) and simulated times series data. Determine and present the ROC curves for the four integration periods. Prepare a complete algorithmic specification. Provide a detailed technical and test report that provides for the transition of this technology into the Navy signal processing community.

PHASE II: Develop and implement on a commercial computer the algorithmic design of Phase I and perform a demonstration which detects a slow speed diesel-electric submarine from data supplied by the Navy's Full Spectrum Data base.

PHASE III: Develop and implement a complete coherent detection sub-system on a commercial workstation (programmed in Ada or C) for operational testing on existing or future IUSS array systems at an IUSS site. The products of this work will transition in FY96 into the upgraded image processing demonstrations at the IUSS site at STIC and DSVC.

N93-039 TITLE: Transporting Ada and C Software to Arbitrary Processor Architectures Efficiently

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate efficient mapping of Ada and ANSI Standard "C" programs onto uni-processor architectures

DESCRIPTION: Demonstrate and transition to the Navy a software tool to map (compile) Ada and ANSI Standard C programs onto uni-processors architectures which have been described by the hardware description language (HDL) ANSI/IEEE-1076 which is called out in Requirement 64. The intent is to extend this software tool to multiple processors. For such computing hardware the requested tool will convert Ada and code to the correct micro-coded instructions which will execute at greater than 85% efficiency of good hand coded micro-instructions of the same function program. As an extension of the requested tool,

the tool should be able to analyze user programs written in Ada and C and automatically and rapidly design the optimum processor for these programs based on HDL described parts in the tool's library. Each phase will require an initial brief including program objectives, actions and a milestone review; a final review and brief; and a final report.

PHASE I: Phase I will demonstrate on Anti-Submarine Warfare (ASW) processing programs the requested capabilities of the software tool plus any other features. Phase I should also provide a detailed test and technical report. An outline of a Phase II demonstration of concept should be included.

PHASE II: Phase II should extend and implement the tool for multiple processors and processors with co-processors architectures. An optimum signal processing workstation will be designed using off-the-shelf commercial components for a Navy provided algorithmic processing chain.

PHASE III: Phase III will develop and implement the ASW processing on the workstation designed in Phase II. Transition: Surveillance Direction System

N93-040 TITLE: Acoustic Warfare Management System

CATEGORY: Advanced Development

OBJECTIVE: Provide an acoustic warfare management system which will coordinate U.S. Navy acoustic programs with U.S. air, surface and sub-surface forces

DESCRIPTION: The U.S. Navy requires a tactical decision aid to integrate information from the Integrated Undersea Surveillance System with that from other U.S. services. The system must include resource allocation and resource optimization, electromagnetic communications management, all-source data fusion, battle management, advanced graphics presentations and a tactical metric. These ends may be achieved through expert systems, Bayseian networks, gaming theory, or other methods. Each phase shall require an initial brief including program objectives, actions and a milestone review; a final review and brief; and a final report.

PHASE I: Phase I will consist of requirement definition, and high level and detailed design. A final report should be submitted summarizing the results of all analysis and comparing the performance of all systems analyzed. An outline of a Phase II demonstration of concept should be included.

PHASE II: Phase II should demonstrate a proof of concept system. In Phase II the design should be implemented on a DTC II computer. Test data will be supplied by the Navy.

PHASE III: It is anticipated that successful Phase II contractors will transfer their technology into the Surveillance Direction System Research and Development program or the Integrated Undersea Surveillance System. Transition: Surveillance Direction System.

N93-041 TITLE: Automated signal processing for the Integrated Undersea Surveillance System

CATEGORY: Engineering Development

OBJECTIVE: Improve timelate, system detection and classification through automated signal processing

DESCRIPTION: The areas of reporting time, detection and classification are currently very labor-intensive. Space and Naval Warfare Systems Command requests proposals to automate these areas either in part or in whole. Proposed systems should significantly reduce the amount of time required to analyze data or to produce accurate reports. Phase I shall be a concept review, analysis study and high level design for proposed area. In Phase II promising automation concepts shall be implemented, installed and tested at a Naval Ocean Processing Facility. Each phase shall require an initial brief including program objectives, actions and a milestone review; a final review and brief; and a final report.

PHASE I: Phase I should report on feasibility, anticipated cost and estimated performance level achieved by the method. An outline of a Phase II demonstration of concept should be included.

PHASE II: Phase II should demonstrate a proof of concept system.

PHASE III: It is anticipated that successful Phase II contractors will transfer their technology into the Surveillance Direction System Research and Development program or the Integrated Undersea Surveillance System at the sensor system level. Transition: Surveillance Direction System, Integrated Undersea Surveillance System

N93-042 TITLE: Logistics Technology Forecast Tool for Hardware and Software including NDI

CATEGORY: Exploratory development

OBJECTIVE: Develop a Logistics Technology Forecast Tool to Improve Reliability and Maintainability performance

DESCRIPTION: Currently logistic support systems lack methods to accommodate the rapidly changing approaches to development and deployment of new and upgraded systems. For example, new technology or Non Development Items (NDI) make the potential reliability and maintainability (R&M) performance of a new system better or qualitatively different from predecessor systems. Yet, reliability and maintainability values which traditionally have been set at the outset of programs, are based on historical values from existing systems which may be very conservative compared to the current state of the art.

New systems are now characterized by a shortened development cycle, increased life-cycle costs, rapid and substantial advances in technology and, the use of off-the-shelf NDI hardware, software and systems. To reflect the current state of development and deployment, a logistics technology forecast tool needs to be defined and developed. An improved methodology would assist program office personnel and logisticians who specify logistics requirements to reduce costs, improve quality and mitigate risks. This tool should include an approach for 1) identifying technology opportunities relevant to the user's programs, 2) comparing technology time frames to program time frames, 3) setting requirements that are neither obsolete nor technically risky 4) adapting to technical risk implications and, 5) understanding cost. Each phase shall require an initial brief including program objectives, actions and a milestone review; a final review and brief; and a final report.

PHASE I: Phase I should present the concept, approach and a design for the Logistics Technology Forecast Tool. An outline of a Phase II demonstration of concept should be included.

PHASE II: Phase II should demonstrate a proof of concept system.

PHASE III: It is anticipated that successful Phase II contractors will transfer their technology into the Surveillance Direction System Research and Development program or the Integrated Undersea Surveillance System at the sensor system level. Transition: Surveillance Direction Systems, Advanced Deployable Systems, Fixed Distributed Systems

N93-043 TITLE: Automatic Detection and Tracking of Acoustic Signals of Low Signal-to-Noise Ratio (SNR) Using Innovative Beamforming and Three-Dimensional Tracking Algorithms

CATEGORY: Exploratory Development

OBJECTIVE: Develop, demonstrate, and test new and innovative beamforming, peak picking, and three-dimensional tracking algorithms for automatic detection and tracking of the full spectrum of acoustic signals including narrowband, SWATH, and broadband energy that have very low SNR

DESCRIPTION: Conventional Beamforming (CBF) is the optimum detector for a very idealized set of noise and signal characteristics that are virtually non-existent in the ocean environment. Matched filed processing addresses the actual signal propagation environment but requires extensive computer processing power. This task is to develop non-intensive, non-conventional, plan-wave computer beamforming methods that use innovative data thresholding algorithms with new signal peakpicking techniques for application to low SNR signals. To reduce false targets, three-dimensional (level vs. time, bearing and frequency) trackers should be developed to process the beam output data. Dynamic ways to normalize the beam output data relative to highly directional noise fields should be incorporated into the processing method. The processing methodology should be able to detect and automatically track narrowband SWATH and broadband signals of low SNR.

PHASE I: Develop the processing method, implement it in software, and demonstrate its performance on real data (supplied by the Navy) for narrowband and SWATH type signals. Measures of effectiveness will be the s+N/N estimate levels detected and the number of false target tracks (per frequency bin and azimuthal sampling interval) at the output of the three dimensional tracker.

PHASE II: Extend the processing method to detect and automatically track broadband energy. Split-array beam correlation techniques should be integrated with the peak picking algorithm and three-dimensional tracker to automate detection and tracking of broadband signals. Real data will be furnished by the Navy for test and evaluation performance. If signal processing method proves to be successful, develop a software/hardware design to implement the method at low power for use in a remote site.

PHASE III: This work will transition to the SPAWAR PD-80 Fixed Distributed System signal processing and/or the Surveillance Direction System.

NAVAL SUPPLY SYSTEMS COMMAND

N93-044 TITLE: Industrial/Supply Information Interface Development

CATEGORY: Advanced Development

OBJECTIVE: Design system interfaces between Industrial requirements ADP systems and retail inventory management ADP systems that enable two way transfer of material requirements and inventory data.

DESCRIPTION: DOD has directed Navy to significantly reduce its repair parts inventories. Prior to DOD's direction, three levels of inventory were authorized - wholesale, intermediate and consumer. In order to comply with DOD's direction, Navy will eliminate it's intermediate level of spare parts. In addition we are looking at the benefits of consolidating consumer level management and inventory position. Today, Navy's industrial activities (shipyards, aviation depots, etc.)maintain individual consumer levels, managed by their own ADP systems. Navy stock points use ADP inventory management and inventory processing systems designed to support intermediate level requirements. When industrial inventories are migrated to supply activities responsible for managing consolidated consumer inventories the necessary ADP system integration needs to be in place. The ADP systems need to be able to transfer material requirements data and inventory availability and requisitioning data between both the industrial customers and the supporting supply activity.

PHASE I: Determine feasibility of interfacing industrial ADP systems with new/revised consumer level supply ADP systems.

PHASE II: Development and delivery of the interfacing systems.

N93-045 TITLE: Application of Desktop Manufacturing to Part Digitizing Systems

CATEGORY: Exploratory Development

OBJECTIVE: To use desktop manufacturing in part digitizing machines to aid design and manufacturing people in user friendly production of mechanical parts.

DESCRIPTION: The Navy reverse engineers mechanical parts to develop technical data packages on systems that are no longer supported by industry. The reverse engineering process is accomplished with automated laser scanners and manual methods. The resulting technical data packages are used for competitive procurements or for manufacturing emergency parts. It is costly to manufacture a prototype mechanical part just to validate the technical data against the original part, before a competitive procurement.

PHASE I: Should conceptualize, design and assess feasibility of an interface between a part digitizing laser scanner and a desktop manufacturing system. Attention should be given to mapping of hidden part features into digital format resulting in a user friendly display.

PHASE II: Prototype and demonstrate an interface between part scanner output and input to a desktop manufacturing system. Included in this design prototype should be a CAD/CAE/CAM workstation interface to capture, edit and output intelligent digital data format.

PHASE III: Phase III is anticipated with other DOD laser scanners.

NAVAL AIR SYSTEMS COMMAND

N93-046 TITLE: TOMAHAWK Command Information Accountability in a GLOBIXS Network

CATEGORY: Advanced Development

OBJECTIVE: Determine an end accountability scheme for TOMAHAWK Command Information (TCI) appropriate to systems residing on a virtual network.

DESCRIPTION: TOMAHAWK cruise missile missions are developed by planning centers subordinate to the Atlantic and Pacific theater commander. Under the Copernicus concept, TCI associated with these missions would be provided by the planning centers to the CINC Command Center (CCC) upon request, using a GLOBIXS network for data transfer. Algorithms

suitable for ensuring proper end accountability for TCI with multiple systems cohabiting a virtual network are needed.

PHASE I: The contractor will develop technical data which identifies the unified commander's specific TCI information requirements (data types), the appropriate data path and projected network data loading, associated security requirements, and a scheme for maintaining end accountability of the command information. The contractor will develop and demonstrate a simulation of the network and accountability scheme.

PHASE II: The contractor will refine the accountability scheme developed during phase I and complete and deliver the final algorithms.

PHASE III: A Navy funded Phase III effort is anticipated.

N93-047 TITLE: Fiber-optic Bundle Reliability Improvement Analysis

CATEGORY: Engineering Development

OBJECTIVE: Improvement of the manufacturing, wrapping, flexibility parameters of high density fiber-optic bundles used in Helmet Mounted Displays.

DESCRIPTION: High density fiber-optic bundles are being used to transmit projected images in helmet mounted display technology. The bundles contain up to 4 million fiber-optic strands, and are constrained by transmissivity to a length of 2 meters. At present, normal utilization and flexation cause thousands of strands to break over a very short term (two weeks to one month). Small business is to investigate industry wide approach to fiber optic manufacture, bundle composition, cause of breakage at flexation points, industry approach to improving reliability of fiber-optic bundles.

PHASE I: Small business will prepare a report describing the process for manufacture of fiber-optic strands and bundles, and explain properties causing currently experienced low reliability. Report will also address general industry practices being instituted to improve fiber-optic bundle reliability.

PHASE II: Small business will prepare a technical plan defining specific alternatives for improving the reliability of fiber-optic bundles while maintaining the flexation properties necessary for utilization in helmet mounted displays. Plan will address the technical requirements for modifying manufacture and/or construction of fiber-optic bundles to accommodate helmet mounted displays, and will include cost analysis and risk assessment.

PHASE III: Successful accomplishment of phases I and II would be followed by implementation of the most cost effective technical improvement product/process modification. The small business would participate in the overall evaluation of the technical process and provide a critique which quantifies potential cost savings to both government and industry.

N93-048 TITLE: Field Replacement and Mass Discrete Retermination of V-22 Connectors/Flat Wire Cables Without Solder

CATEGORY: Engineering Development

OBJECTIVE: To develop a mass termination method and tool for rectangular connectors/flat solid-wire cables that can be hand-held and used on-board V-22 aircraft (in-place) in very adverse field environments without the use of solder.

DESCRIPTION: The current solder mass termination technique is an acceptable method for aerospace factory use but is unacceptable for military field use in adverse conditions such as sand/dust and low temperature on-board carrier environment. Also a broken contact in the current design requires the retermination of as many as forty (40) circuits and the retesting of these circuits.

PHASE I: This study must take into account the constrained work areas on-board the V-22 aircraft where connector replacement and retermination must be accomplished. Methods and tools will be studied that can be easily and permanently calibrated and which will sustain the abuse environment of hand-held tools. A permanent and reliable flat wire-to-connector contact connection (without solder) will be produced to meet the original performance specification requirements to which the connector/contact/flat wire cable assembly (previously with solder) was qualified. If no such existing method or tool can be found, the study shall propose the development of a specific method/tool/connector contact design that will be adaptable to the existing rectangular connector on the V-22 aircraft, and provide for individual replacement and retermination of one contact without disturbing others.

PHASE II: Phase II will either assemble existing tools and connectors, demonstrate an acceptable process and test to prove performance, or develop a prototype tool and connector contact and demonstrate performance of the new system.

PHASE III: Possible Phase III for V-22 in-situ repair kit.

COMMERCIAL APPLICATION: Exists in commercial aviation or where similar conditions to those described above exists.

NAVAL MEDICAL COMMAND

N93-049 TITLE: Non-invasive In Vivo Tissue Bubble Detector

CATEGORY: Advanced Development

OBJECTIVE: Develop a bubble detector that can quantitatively measure a bubble population within the volume of an in vivo specimen, using non-invasive, non-destructive techniques.

DESCRIPTION: Advances in decompression research require the ability to detect and measure the number and size of bubbles that form and grow in situ in the soft solid tissues of biological specimens. Non-invasive, non-destructive detection techniques are mandatory. The detector must quantitatively measure bubble populations between 10 microns (μ) and 1000 microns (μ). Both the absolute size of the bubbles, and the bubble count for each size are needed. The device will be of practical research value if it can interrogate tissue volumes of at least one cubic centimeter (1 cc). Larger volumes are preferable. Since bubble formation and growth in tissue is a dynamic process, and may occur rapidly under conditions of severe decompression stress, shortest possible specimen interrogation times are desired. Interrogation times should be on the order of hundreds of milliseconds, if possible. Instrument output must be in a format that allows direct and real time use by computer hardware and software for data recording and statistical analysis. The final deliverable will include all hardware and software that is needed to provide a computer monitor and hardcopy print out of absolute bubble size and population distribution. The device must be capable of enduring an indefinite number of exposures to rapid compression/decompression between ambient (sea level) pressure and approximately one thousand feet of sea water pressure (460 pounds/in^2).

PHASE I: At the end of the six month effort, the expected product is a detailed technical report evaluating the likelihood that a working prototype of the above-described bubble detector can be fabricated within the subsequent two years. The report should include an examination of all candidate technologies to achieve the objective, and a detailed justification for selecting the preferred technology. All anticipated theoretical and practical impediments to prototype development, including problems of instrument calibration should be addressed explicitly, along with the detailed strategy for overcoming those impediments.

PHASE II: At the end of a two year effort, the expected product will be a fully functional prototype bubble detector that meets or exceeds the specifications described above in the OBJECTIVE and DESCRIPTION sections of this document.

PHASE III: A phase III effort is anticipated, for refinement of the prototype, as well as for the preparation and delivery of finished units. Finished units will include an owner's manual containing both use and maintenance instructions. All items for user calibration will be included with the finished units if the detector design requires periodic user calibration.

NAVAL SEA SYSTEMS COMMAND

N93-050 TITLE: SSN21 Battery Floating Voltage Equalizer

CATEGORY: Exploratory Development

OBJECTIVE: Develop a voltage equalizer ensuring proper floating voltage for full charge of each battery cell on SSN21, thereby also extending its life and reducing maintenance.

DESCRIPTION: Manufacturing tolerances, impurities in make-up distilled water and aging cause variations in floating conditions between the battery cells to remain fully charged. When a cell is not fully charged, its voltage level falls and its plates become sulphated. As a result, a cell will lose capacity.

PHASE I: Assess state-of-the-art systems for controlling battery float voltage. At the end of the first month, provide a letter report summarizing the results to the government for information.
Design and fabricate breadboards for testing with a minimum of two test circuits of six SSN21 battery cells at a Government battery test facility in accordance with a test plan provided by the Government.

PHASE II: Upon successful completion of Phase I demonstration, prepare for government approval a procurement specification for an Engineering Development Model.

Design and fabricate Engineering Development Models for testing with a minimum of two test circuits of the SSN21 battery cells for one year. Document the manufacturing process in detail as it actually occurs. Provide level 2 drawings for the Engineering Development Model. Prepare a final report on the Engineering Development Model test results. In this report, discuss test results, limitations of the design, design changes to improve performance and reduce production cost, recommend manufacturing process improvements and discuss lessons learned.

PHASE III: Navy funding - to qualify this hardware for shipboard installation - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

N93-051 TITLE: Crevice Corrosion Prevention

CATEGORY: Exploratory Development

OBJECTIVE: Development of a method to reliably provide cathodic protection (or other method of preventing Crevice Corrosion) at the flange faces of Alloy A-625 pipe flanged connections.

DESCRIPTION: The proposed method must apply to a large number of sites on shipboard piping systems (on the order of 100-500 sites). Cost should be less than or equal to the application costs of Hastelloy C-276 weld overlays. A cost breakdown for a typical C-276 welding task is available from the Defense Technical Information Center.

PHASE I: Develop the proposed approach by demonstrating that the proposed electrochemical (or other) solution is feasible and will probably be both effective and cost-effective. Provide complete schematics or diagrams of the proposed methodology as it would be applied to a simple pump loop piping system with at least five flanged connections. Identify associated operation and maintenance requirements. Provide a detailed test plan, schedule and cost estimate for Phase II.

PHASE II: Run a minimum of a one year test on no less than ten, 4" (pipe size) mated flange samples in 6 fps flowing ASTM (or natural) Seawater and ten similar samples in quiescent ASTM (or natural) seawater, each with at least five control samples. Demonstrate that the applied methodology prevents crevice corrosion well within the normal temperature range of natural seawater. Develop application or installation procedures for the proposed methodology as they apply to both piping systems already in operation, and those not yet built (if different).

PHASE III: Navy funding - to pursue installation of a fully operational prototype system on SEAWOLF - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

N93-052 TITLE: Electromagnetic Interference Qualification of Submarine Components by Extension

CATEGORY: Exploratory Development

OBJECTIVE: To develop an extension plan or tool for Electromagnetic Interference (EMI) qualification of equipment, specifically motors, used on SEAWOLF Class submarines, with potential use for future ships.

DESCRIPTION: SEAWOLF Ship Specifications require all motors to be tested to demonstrate the EMI requirements of MIL-STD-461C, "Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference" are met. There are numerous motors used on SEAWOLF that are similar in design and could potentially be qualified by extension after successful EMI testing of similar motors (same manufacturer, same basic design). This effort is intended to provide a cost effective means for qualifying motors to the EMI standards of MIL-STD-461C.

PHASE I: Phase I should determine if a family of motors from one manufacturer and of similar design can be qualified by extension after testing a sample set of motors (i.e., the smallest size motor and the largest size motor). The criteria for motors to be considered for extension should be determined. The limits on differences between motors to be extended and the actual motor(s) tested should be established.

PHASE II: Develop a user friendly manual which provides quantitative and qualitative EMI extension methods. The Phase II effort shall verify the accuracy and determine the limitations of the quantitative and qualitative extension techniques. Phase II efforts would involve proving the acceptability of the Phase I developed plan and criteria through application and testing. Provide change pages for updating MIL-STD-461.

N93-053 TITLE: Fault Tolerant Processor (FTP) Life Cycle Maintenance

CATEGORY: Advanced Development

OBJECTIVE: Define troubleshooting and repair requirements for SEAWOLF FTPs for life cycle maintenance including diagnostic software, card testers, and system analyzers.

DESCRIPTION: Submarine ship control requires highly reliably hardware components, which include FTPs. Life cycle maintenance of FTPs is an important aspect of ship's maintenance, and state-of-the-art techniques for testing and troubleshooting need to be explored. Requirements for life cycle maintenance of the FTPs need to thoroughly examined in order to incorporate the latest diagnostic tools such as diagnostic software, specialized card testers, and system analyzers. A security level of CONFIDENTIAL is required for personnel and the facility.

PHASE I: Evaluate and analyze the FTP troubleshooting and maintenance requirements and how they can be accomplished. Produce a final report containing the maintenance requirements and outlining a plan for implementing the life cycle maintenance plan.

PHASE II: Design and develop prototype hardware and software to perform troubleshooting and diagnostics on the FTPs including specifications and drawing of the diagnostic and test tools that have been developed.

PHASE III: Navy funding - to develop finalized production specifications and drawings for the life cycle maintenance tools; code, build or procure the diagnostic and test tools based on the approved specifications and drawings; and develop an implementation/installation plan for the tools on board submarines and at testing facilities - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

N93-054 TITLE: Remote Battery Disconnect

CATEGORY: Advanced Development

OBJECTIVE: Minimize energy input from the SEAWOLF Submarine Emergency Propulsion Battery to a fire or other uncontrolled discharge by isolating the battery into as many segments as possible.

DESCRIPTION: The device or subsystem must be operable from a remote location, cannot be intrusive of normal battery operation, even under emergency conditions, and must be highly reliable, the system easily restored to normal operation after isolation, and the isolation device or subsystem maintainable by ship's force personnel.

PHASE I: Develop the concept proposed; schematically or pictorially show its operational and physical interfaces with the SEAWOLF battery installation, generally describe its operational and maintenance requirements; provide detailed Phase II development schedule and cost estimate.

PHASE II: Provide detailed design for Navy approval of the proposed 'breadboard' prototype, build, test and demonstrate the approved 'breadboard' prototype system on actual SEAWOLF battery cells. Submit a final report on the test results.

PHASE III: Navy funding - to pursue first article manufacture and qualification for use on the SEAWOLF Submarine - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

N93-055 TITLE: Light Weight Syntactic Foam

CATEGORY: Exploratory Development

OBJECTIVE: Develop a Syntactic Foam or similar material which can be used to provide positive buoyancy to submarines by filling void spaces.

DESCRIPTION: The material must have a density not greater than 20 pounds per cubic foot, and a coefficient of compressibility not less than 150ksi (200ksi is desirable). Water absorption must be near zero. Any containment must be included in the density calculation.

PHASE I: Locate and describe the current status of research for the basic material structure proposed, develop methodologies for manufacture and test of the proposed material; and provide justification supporting why the proposed material

is expected to meet the objective requirements. Provide a detailed Phase II plan, schedule and cost estimate.

PHASE II: Manufacture and test sample material. Provide samples to the Navy for independent comparison tests. Demonstrate density, compressibility, water absorption, acoustic qualities (noise generation and/or absorption of a sample installation under simulated at-sea conditions) and shock resistance.

PHASE III: Navy funding - to pursue first article qualification for use on SSN 21 and other submarines - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

N93-056 TITLE: Galley Exhaust Hood Improvement

CATEGORY: Advanced Development

OBJECTIVE: To improve the grease and aerosol removal efficiency and thereby eliminate the fire hazard and maintenance burden of the Galley Exhaust hoods aboard Navy submarines and surface ships.

DESCRIPTION: The Primary considerations for design of the galley exhaust hoods are the ability to capture, contain, and remove the heat and aerosols (grease, smoke, water vapor, etc.) being generated during the cooking process. The hood design must prevent the aerosols from contaminating the exhaust ductwork and components located downstream of the hood. Present contamination creates a potential fire hazard and increases maintenance efforts in ductwork downstream of the hood. Studies completed by the Navy, as well as, experience reported from the fleet, indicate that the galley exhaust hoods used in both submarines and surface ships do not adequately remove grease aerosols from the galley exhaust air. The exhaust hoods use an inertial type mechanism for grease removal. ASHRAE has reported that inertial extraction methods are ineffective for particle sizes less the 5 microns. The Navy study also revealed that during the cooking process, the particle distribution ranged from less than 1 microns to 35 microns. The objective of this topic is to develop a galley exhaust hood that will remove all aerosols, including those less than 5 microns. The final hood design must meet the vibration, shock, and acoustic requirements for SSN 21. The ideal galley exhaust hood design would require minimal retrofit changes on submarines and surface ships.

PHASE I: Upon completion of Phase I, the proposer should have completed a concept demonstration of a device/system which will efficiently remove grease and aerosol particles ranging from 1 micron to 35 microns. Testing of the concept design shall demonstration particle removal efficiency versus particle size (from 0 to 45 microns), versus particle quantity in parts per million, versus time duration in hours, and versus air flow rate in cubic feet per minute. Periodicity for maintenance actions shall be developed and reported.

PHASE II: Upon completion of Phase II, the proposer should have a working model of a galley exhaust hood system which will replace Navy shipboard galley exhaust hood systems. Ideally the galley exhaust hood system design would replace the galley exhaust hoods on Navy submarine and surface ships without requiring modifications to the ship design. The model should incorporate the concept device of Phase I and meet the vibration, shock and acoustic requirements for SSN 21.

PHASE III: Navy funding - to complete first article qualification for installation aboard SSN 21 with potential backfit installations aboard Navy submarines and surface ships having galley exhaust hood grease removal problems - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

N93-057 TITLE: Seawater Distilling Plant Steam Overpressure Trip Valve

CATEGORY: Engineering Development

OBJECTIVE: Develop a design for a noise quiet cost effective seawater distilling plant steam overpressure trip valve for use on submarines.

DESCRIPTION: The Navy needs a low noise and low cost steam overpressure trip valve for use in the steam supply piping of seawater distilling units aboard submarines. Innovative low cost concepts are sought which meet distilling plant requirements and the SSN 21 acoustic requirements. Confidential level, facilities will be required for acoustic evaluation.

PHASE I: Develop multiple design concepts for Navy consideration. Provide a report with concept drawings which discusses the limitations, pros and cons of each design. Compare the production and life cycle costs of each design. Identify possible changes to Spec PSSSN21C-388 which would lower procurement costs while satisfying the valve functional requirements. Provide supporting rationale and analyses for recommended changes to PSSSN21C-388 for each concept.

Emphasis of design attributes will be quietness, manufacturing cost, simplicity of concept, reliability and life cycle cost.

PHASE II: Design and build a prototype for the valve concept selected by the Navy and evaluate performance and acoustic capabilities by testing. Design the valve to satisfy PSSSN21C-388 with cost reduction changes, as approved by the Navy. Develop a manufacturing process plan prior to manufacture. Manufacture the valve and document the manufacturing process as it actually occurs. Simulate full scale production during the manufacturing process vice single prototype fabrication methods. Test the acoustic and functional performance of the valve. Make design changes and manufacturing process changes, based on manufacturing feedback and test results. Manufacture the new valve design and document the manufacturing process as it actually occurs. Test the acoustic and functional performance of the new valve. Document both valve designs and changes, manufacturing processes and changes, test results, and lessons learned in a final report. Identify recommendations which could further improve valve performance and reduce manufacturing cost.

PHASE III: Navy funding - to complete first article qualification (e.g. endurance, shock and vibration) for use on SSN 21 and other Navy ships - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

COMMERCIAL APPLICATION: Commercial shipping, desalinization plants, etc.

N93-058 TITLE: Effect of Fouling on Acoustic Performance of Fan Outlet Devices

CATEGORY: Research

OBJECTIVE: Quantify the loss of acoustic attenuation created by fouling of outlet devices on SSN 21 vaneaxial fans, and recommend maintenance practices necessary to sustain design performance.

DESCRIPTION: Outlet devices are used on SSN 21 vaneaxial fans to attenuate fan generated noise. Several of these devices use a compressed felt metal material which is known to be come less effective with fouling. The fouling is a combination of lint and condensed aerosols. Oil contamination is considered the primary reason for loss of acoustic attenuation. Inorder to develop an effective maintenance action plan, the Navy must be able to quantify the loss of attenuation versus fouling rate. A Confidential facility clearance is required for this effort.

PHASE I: Develop a test plan and procedure to measure acoustic levels downstream of several SSN 21 fan compressed felt metal outlet devices, and to evaluate several possible methods for cleaning the outlet devices. Prepare the test plan and procedure to simulate 15 years of use in a typical submarine engine room environment to evaluate a) the loss of acoustic attenuation versus in-service time due to fouling; b) the effectiveness of cleaning techniques; c) the effect drying time has on acoustic attenuation for wet cleaning methods; d) time required to clean the outlet devices; e) degradation of the compressed felt metal due to fouling and cleaning. Develop possible design changes to extend the effective operating period of the outlet devices. These design changes should be within the capability of Ship's Force. Include these design options in the test plan.

PHASE II: Conduct tests and evaluations per the Navy approved Phase I test plan and procedure. Provide an in depth report which discusses the test results and lessons learned. In the report, provide recommended periodicities for performing each cleaning method studied, and possible design changes to improve long term performance of the outlet devices.

N93-059 TITLE: Improved Adhesives for Seawater Applications

CATEGORY: Exploratory Development

OBJECTIVE: Develop alternative adhesives for bonding non-metallic materials to metals for use on U.S. submarines in a seawater environment (this adhesive would be used primarily to bond a new proprietary polymer alloy bearing material to Cu-Ni and alloy 625).

DESCRIPTION: The Navy has develop a new acoustically superior propulsion system bearing design that uses a polymer alloy bearing material. The design requires that the polymer alloy material be bonded to copper-nickel and alloy 625 shells for installation into the bearing housing. The objective is to develop an adhesive material that is easy to apply, cures at room temperature and will not debond in temperature ranges of at least 0-100 F.

PHASE I: Conduct a study to evaluate alternative adhesive materials for the application described and make recommendation for the adhesive that best meets the stated requirements. Provide a report which describes the limitations, pros and cons of the adhesives studied. Describe the effort that would be required to complete a phase II effort.

PHASE II: Fabricate and test samples of bearing material adhesion to copper-nickel and alloy 625 to evaluate bond strength before and after thermally cycling the sample through the minimum temperature range specified. Conduct shock and vibration tests to evaluate structural integrity of the bond. Provide description of Phase III effort.

PHASE III: Navy funding - to pursue testing in the actual application - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

N93-060 TITLE: Methodology and Tools for Improving Logistics Information Systems in Ship Acquisition and Support

CATEGORY: Exploratory Development

OBJECTIVE: The development of methodologies/tools which facilitate the Navy's assimilation and display of logistic engineering data for ship acquisition and support.

DESCRIPTION: Various computerized tools and data bases have been developed which have improved the management and assimilation of logistics and engineering data associated with ship acquisition and support including the LSAR, ROMIS and SCLSIS. At some time in the future when the CALS initiative is realized these data bases will be integrated with others to facilitate integrated display and exchange of common data. A major need exists, however for additional methodologies and tools which can be implemented in the near term to help the Navy further improve the accuracy and availability of required data during the ship acquisition process and serve as a focus for the CALS architecture.

PHASE I: Develop concepts for the candidate architectures and methodologies and provide a rationale for; (a) the utility of the final product in increasing the efficiency and effectiveness of the ship acquisition and support process and (b) the feasibility of near term implementation of the proposed concepts.

PHASE II: Refine the concepts proposed in phase I and the development of prototype tools.

N93-061 TITLE: Methodology and Tools for Improving the Effectiveness of Acquisition Logistics Training

CATEGORY: Exploratory Development

OBJECTIVE: To develop methodologies/tools to increase the effectiveness of the Navy's acquisition logistics training.

DESCRIPTION: In recognition of the fact that logistic requirements have increased dramatically over the past fifteen years, there is increased emphasis on streamlining the logistic process to (1) eliminate redundant requirements, (2) increase the quality of data, and (3) increase the level of integration between logistics and engineering. In concert with these streamlining initiatives, and in an effort to increase the degree to which logistic considerations are factored into the design process, a major need exists to provide training on the streamlined logistic requirements to acquisition support personnel within both the engineering and logistics communities.

PHASE I: Phase I should develop candidate training concepts, implementation methodologies and tools for providing acquisition logistic training to disparate groups of acquisition professionals and should provide strong rationale for both (a) the feasibility of implementing the proposed concepts and (b) the utility of the final product in increasing the effectiveness of the Navy's acquisition process.

PHASE II: Phase II would involve the refinement of the concepts developed in Phase I and the development/delivery of a prototype system.

N93-062 TITLE: Microwave Filter

CATEGORY: Exploratory

OBJECTIVE: Development of a microwave tunable filter suitable for use in transmit/receive modules.

DESCRIPTION: Many modern radar and communications concepts employ microwave transmit/receive (T/R) modules. It is desirable to use a T/R module with a large bandwidth. However, using broad band modules with filter selectivity results in susceptibility to receiver spurious responses. Additionally, selectivity permits higher transmit power amplifier efficiencies. It is desired that an innovative tunable filter be developed and demonstrated for T/R module use. The primary purpose of the filter

is to improve power amplifier efficiency. As such, the electrical and mechanical interface with the T/R module must be considered. Such a filter should have characteristics of the following order:

Frequency:	1 to 20 Ghz (One filter type need only cover a 50% bandwidth)
Bandwidth:	Less than 10% of center frequency with 30 Db suppression
Power handling:	Greater than 40 Dbm
Tuning response:	Less than 10 microseconds
Insertion loss:	Less than 0.25 Db
Size:	Compatible with a single element T/R module.
Power:	Less than 250 milliwatts

PHASE I: Develop filter concepts for Phase II construction and evaluation.

PHASE II: Perform detailed design, build, and test of candidate filters.

PHASE III: Navy funding is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and quality of the results produced.

N93-063 TITLE: Near Ocean Environment Sensor

CATEGORY: Exploratory

OBJECTIVE: Development of an near ocean environment sensor. Detailed knowledge of the near ocean environment is needed as an input to radar ducting and electro-optical sensor models used to predict the performance of shipboard surveillance systems.

DESCRIPTION: The primary requirement is for a sensor that provides near real time reports of refractivity profiles from a given surface ship to the horizon. Refractivity over both land and ocean should be considered. Additionally, it is desired that the sensor measure wave heights and provided directional information. The sensor must employ remote sensing techniques; i.e. radiosondes are not permissible. The sensor may be located shipboard, or existing offboard assets may be fused aboard ship to provide the required data.

PHASE I: Conduct a feasibility and design study. Sensor performance requirements should be defined, and a system concept formulated. A critical design review should be conducted and a final report issued.

PHASE II: Fabricate a field test unit, and define a production design. Preliminary testing should be conducted in a laboratory environment followed by at least two ocean trials. A critical design review should be conducted prior to each test. A complete system design will then be finalized and final report issued.

PHASE III: Navy funding is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and quality of the results produced.

N93-064 TITLE: Sensor Tactical Decision Aid

CATEGORY: Advanced Development

OBJECTIVE: Development of a sensor tactical decision aid. In the future, the Navy may be faced with surreptitious attacks in a situation of undeclared war. The locale of the future is likely to be littoral. This environment stresses the performance of sensors such as radar and infrared. Threats may also be masked by terrain or countermeasures.

DESCRIPTION: It is desired that a system which predicts the performance of radar and infrared (IR) in a littoral environment be developed. The system should utilize fundamental radar parameters such as power, pulse width, beam programming, and sub-clutter visibility. Analogous factors should be considered for IR. Radar, but not IR, propagation factors due to non-linear refractivity profiles should assumed to be supplied. However, environmental factors such as target characteristics, weather, season, time of day, and terrain must be considered in this development.

PHASE I: The proposed design approach including data inputs and outputs, equipment, computer program functions, and operator interactions should be documented. A skeleton system with rudimentary capability should be demonstrated at completion of Phase I.

PHASE II: One system should be prototyped in its entirety and evaluated in a laboratory and field environment.

PHASE III: Navy funding is contingent and may be provided depending upon the proposals received, the Naval

priorities assigned the Phase III efforts, and quality of the results produced.

N93-065 TITLE: Frequency Synthesizer

CATEGORY: Research

OBJECTIVE: Development of a high performance affordable frequency synthesizer.

DESCRIPTION: Many radars and communications systems employ microwave frequency synthesizers. It is desired to extend the benefits of frequency synthesis to a broader range of applications including missiles. Such application has been limited due to cost, weight, and space constraints. Such a synthesizer should have characteristics of the following order:

Frequency Range: 12 to 14 Ghz
Tuning Response: Less than 10 microseconds
Frequency Settability: 1 Mhz
Size: Less than 0.2 cubic feet
Weight: Less than 5 pounds
Stability: Equivalent to best commercial synthesizers

PHASE I: Develop a concept for the synthesizer and quantitatively predict its performance.
PHASE II: Perform detailed design, build, and test of the Phase I concept.
PHASE III: Navy funding is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and quality of the results produced..

N93-066 TITLE: Mechanical Seal(s) for Contra-Rotating Propulsion Shafts

CATEGORY: Exploratory Development

OBJECTIVE: Design a mechanical seal(s) for contra-rotating propulsion shafting.

DESCRIPTION: The seal(s) must meet the material and leakage requirements of existing Navy approved seals and be sized for a contra-rotating shaft arrangement driving a pair of contra-rotating propellers with a combined power of 50,000 shp. The design must: adequately seal both shafts, provide for maintenance from inside the ship without drydocking the ship, and be affordable.

PHASE I: At the end of 6 months, the contractor should have designed the seal(s), identified the installation and maintenance requirements and limitations and estimate the unit production cost of the seal(s).

PHASE II: At the end of 2 years, the contractor should have built small (1/10th) scale model of the seal(s) for demonstration at the Navy's lab, incorporated any design changes required as a result of the testing and prepared final drawings of the seal(s). Special design parameters, relationships, etc. must be defined at that time.

N93-067 TITLE: Structural Fabrication Tolerances and Structural Details

CATEGORY: Exploratory Development

OBJECTIVE: Develop the methodology to establish the shipbuilding tolerances and details for ship structures on a reliability basis so as to minimize ship construction cost.

DESCRIPTION: Current Navy specifications for structural tolerances are not based on failure and may be overly conservative. A recent survey, (Ref. (a)), found few criteria for commercial ships. The recommendation of Ref. (a) to develop criteria based on structural reliability is needed to reduce ship construction costs.

PHASE I: Review current ship structure specifications for tolerances and requirements for structural details. Determine if any rational basis other than tradition exists for these specifications. Develop the methodology for application of structural reliability principles to assess the significance of these parameters on ship structural performance. Develop means

of assessing shipbuilding cost to evaluate the impact of alternative requirements.

PHASE II: Analyze ship structure designed in accordance with current specifications for the impact of shipbuilding tolerances and structural detailing on structural reliability. Develop alternative specifications based upon reduced shipbuilding cost. Estimate the cost savings associated with the implementation of these improved specifications.

PHASE III: Based upon the expertise developed in Phase II, market the technology to shipbuilders for the purpose of reducing shipbuilding cost. During this phase the technology should be expanded to include other fabrication techniques, including welding parameters, assembly procedures, and overall structural design. Further extend the methodology to assess defects that occur in service to establish reliability-based maintenance plans.

N93-068 TITLE: Use of Composite Material for MCM Aft Deck Machinery

CATEGORY: Exploratory Development

OBJECTIVE: Development of fabrication method for utilizing composite material for aft deck machinery on minesweeping ships. Past and on-going R&D efforts have demonstrated the feasibility of using composite material for 33-inch diameter propeller shafts and for hydraulic cylinders withstanding 4500 psi internal pressure. Minesweeping machinery is a natural candidate for adopting the use of composite material due to the material's light weight, corrosion resisting and non-magnetic properties. Substantial weight savings would result if the cable reels could be fabricated with composite material.

DESCRIPTION:

PHASE I: Feasibility study on the use of composite material for the manufacture of minesweeping cable reels. Efforts will include investigating the candidate material, the method of fabrication and the method of attachment to metallic material.

PHASE II: Test and evaluation of selected fabrication sample of composite material cable reels will be conducted to verify the applicability of the Phase I study.

N93-069 TITLE: Methods to Reduce Emissions from Diesel Engines

CATEGORY: Exploratory Development

OBJECTIVE: Develop methods to reduce or treat exhaust emissions from Diesel Engines and gas turbines.

DESCRIPTION: The EPA and the California Air Resources Board (CARB) are imposing tighter emission requirements for Diesel engines and Navy Diesel engines will have to comply. Most diesel engine manufacturers are addressing this issue to assure compliance with the proposed requirements. Some of this technology may be retrofitted to existing Naval diesels, however, the cost may be prohibitive. Furthermore, the Navy has diesels which are no longer supported by the manufacturer. Investigate various methods and technologies which could be used to reduce NOx to 600 ppm and 130 ppm for existing and new engines respectively. It is also desired that hydrocarbon emissions be concurrently reduced. Reduction of crankcase emissions should also be addressed. The methodology and hardware configuration should be adaptable to a variety of existing diesel engines.

PHASE I: Develop designs with drawings and engineering calculations which demonstrate the feasibility of reducing emissions from Diesel engine exhaust. The contractor shall provide the impact of the technology on weight, space, effect on arrangements and performance, and the expected unit cost.

PHASE II: Refine the design from Phase I with final engineering calculations and test the system on a Navy laboratory engine to determine its performance, reliability and maintainability. Also, provide an update of the cost estimate.

N93-070 TITLE: Under-ice Remote Detection System (RDS)

CATEGORY: Advanced Development

OBJECTIVE: To develop a system for the detection of ice-borne vibrational signals from both in-transit and ice-picked submarines.

DESCRIPTION: The detection of under-ice targets is a very difficult task due to various environmental factors. Prior

investigations using geophones and hydrophones have confirmed that submarines transiting at normal depths couple significant energy to the ice pack. A complete understanding of the coupling mechanisms is not well understood. The subject system should be capable of detecting energies at long ranges using any available sensing technologies. The system design should compensate for own-ship motion and should be designed for implementation within the limited space requirements of a submarine platform. The system should operate independent of all other surface/sub-surface systems and should require no off-board or AUV-type sensor. The proposed approach should not require any communication through the ice to a detection aircraft and should not require own-ship to come in contact with the ice canopy.

PHASE I: Develop concept design (30-50 pages) that will provide details on operational theory, system design, functional and operational characteristics, and projected cost requirements. Each proposal will be reviewed by a combined Navy, university and consultant team with the successful candidate being chosen for experimental development during Phase II.

PHASE II: Contractor shall develop a detailed system design package and fabricate one experimental sensor system. Contractors shall perform in-house laboratory (bench) testing of system to ensure operability and functionality according to contractor developed, Navy approved, test documentation. A report detailing the results of the in-house testing will be developed by the contractor. NAVSEA will then plan and coordinate at-sea testing of the system. Contractors will assist in at-sea testing and develop a "quick-look" test report 3 weeks after testing is completed and a final Summary Test Report within two months thereafter. The final test report should include an analysis of all recorded data and a detailed assessment of system performance.

PHASE III: Navy funding - for the design and fabrication of an Advanced Development Model (ADM) - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

N93-071 TITLE: Tactical Oceanography Support of Mining and Mine Countermeasures Operations

CATEGORY: Advanced Development

OBJECTIVE: Apply tactical oceanography principals to optimize the efficient employment of mines and mine countermeasure sensors and equipment.

DESCRIPTION: Tactical planners lack an automated planning tool for mining operations that uses detailed environmental and oceanographic data as an input into the development of an optimum minefield design. Environmental factors such as bottom slope, currents, and tides can have a significant impact on the effectiveness of individual mines and the entire minefield. Airborne, surface and Explosive Ordnance Disposal (EOD) tactical mine countermeasures units currently lack automated sensor and equipment employment guidance based on detailed environmental and oceanographic data. The lack of employment guidance hinders effective operational planning and system effectiveness. Specifically, the environmentally driven deficiencies include: Predicted performance (detection and classification ranges against various mine threats) and employment recommendations (sonar depth, pitch, and track spacing) for the variable depth mine hunting sonar based on the historical or in-situ environment of the tasked area;Employment recommendations (such as output ratings and track spacing) for surface and airborne influence countermeasures equipment based on the historical or in-situ environment of the tasked area; and Predicted EOD diving and mine neutralization system employment windows based on predicted acceptable environmental parameters (currents, tides, and visibility). Advances in the connectivity of environmental data (including oceanographic and atmospheric) and the digitizing of related support products such as high resolution charts would permit the development of an automated tool that addresses these needs.

PHASE I: The phase I effort will result in:A detailed evaluation of the critical performance factors associated with current U.S. Navy mines and principal mine countermeasure sensors and equipment; A decision structure for optimum minefield design and optimum employment of the sensors and equipment based the operating environment; A module structure that will integrate within existing decision aids; and A proof of concept software demonstration.

PHASE II: The phase II effort will result in completed development of mining and mine countermeasures tactical decision aids in accordance with the phase I design. The module will be supported by an intuitive, user interface.

PHASE III: Navy funding - for transition of software modules to APP products and integration in existing fleet systems - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

N93-072 TITLE: Multi-Warfare Tactical Decision Aid

CATEGORY: Advanced Development

OBJECTIVE: To develop an embeddable, rule-based expert system to support decision making for multiple emergent Naval warfare missions. This expert system module will contain individual components (one for each addressed warfare area) tailored to the decision support requirements of that mission.

DESCRIPTION: Current tactical decision aids focus on providing commanders with environmental and tactical information necessary to conduct deep water ASW missions. As the focus of Naval warfare shifts to other mission areas (e.g., shallow water ASW, diesel ASW, mine warfare, special warfare, and strike warfare), the decision aids must adapt to new warfare roles. One of the problems to be solved is, given the correct information at the correct level for the current system user, how is the information used in conjunction with specific mission objectives and established mission conduct methods, to optimally employ assets to maximize the potential for success. Different warfare missions will require entirely different approaches and decision planning recommendations. The objective of this research will be to evaluate the decision support requirements for various warfare missions, establish a mission specific rule/knowledge base, and develop an expert system based software module that provides mission planning and execution recommendations as a function of warfare area.

PHASE I: A detailed study of mission related decision criteria and development of a rule base for a selected candidate warfare area (e.g., strike warfare).A design for an expert system based planning and execution module in support of multi-warfare missions planning and execution.A proof of concept software demonstration.

PHASE II: Complete development of the multi-warfare expert system based decision support module described above in accordance with the phase I design. The module will be supported by an intuitive user interface and will be ready for integration within existing fleet tactical decision aids.

PHASE III: Navy funding - for expansion to other identified warfare areas and potentially the tailoring of the module for cross-service applications - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

N93-073 TITLE: Sonar Search Tactics Optimization

CATEGORY: Advanced Development

OBJECTIVE: Perform advanced development of automated track planning optimization considering search mission constraints; searching platform characteristics and capabilities; environmental concerns; and threat definition.

DESCRIPTION: Traditionally acoustic performance prediction (APP) systems provide performance predictions and aid in the development of an ASW search plan, but provide little or no automated support for track planning based on current ASW search tactics. Advanced development related to track planning optimization is required to keep pace with more complex sensor suites, the addition and evaluation of new search tactics, and the increasingly complex task of track planning. The system should support generation of track plans based on search plan, mission constraints, environmental data, and threat definition inputs, and should evaluate candidate track plans with regards to overall search requirements. In addition, any system developed must allow operator interaction at various levels of the optimization process or provide the operator the ability to investigate and override the optimization recommendation.

PHASE I: Develop a prototype track planning optimization software module. The module must be ready for integration within existing fleet tactical decision aids for test and evaluation.

PHASE II: Expand the effort to cover additional sensors/platforms and tactical scenarios.

PHASE III: Navy funding - Extend module applicability to multi-ship track planning - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

N93-074 TITLE: Surface Ship and Submarine Automated Acoustic Search Planning

CATEGORY: Advanced Development

OBJECTIVE: Perform advanced development of automated sonar system employment optimization considering the search mission constraints; searching platform characteristics and capabilities; environmental concerns; and threat definition.

DESCRIPTION: Traditionally acoustic performance prediction (APP) systems provide performance predictions for one acoustic sensor at a time and do not truly support acoustic sensor suite search plan optimization. Advanced development related to sonar

suite search plan optimization for both surface ships and submarines is required to keep pace with more complex sensor suites and the increasingly complex task of search planning. In addition, any system developed must allow operator interaction.

PHASE I: The phase I effort will result in development of a prototype surface ship or submarine sensor suite search planning optimization software module. The module will be ready for integration within existing fleet tactical decision aids for test and evaluation.

PHASE II: The phase II effort will expand the effort to cover additional sensor suites and tactical scenarios.

PHASE III: Navy funding - for transition of software modules to APP products for integration in existing fleet systems - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

N93-075 TITLE: STANDARD LOW COST DISPLAY CONSOLE

CATEGORY: Advanced Development

OBJECTIVE: Develop a low cost submarine combat system display console utilizing mil-std-2036 as a guide or technical requirements and commercial off the components

DESCRIPTION: Development of a low cost multi-function console to support the full range of combat system display functions and Navy requirements for operability (Man Machine Interface), performance, and supportability. Concept shall include initial design utilizing state of the art technology with methodology to allow future cost effective insertion of technology growth.

PHASE I: Phase I would involve development of a procurement specification detailing requirements to procure a universal Next Generation Computer Resources (NGCR) compatible display console to be capable of performing all submarine non propulsion electronics display functions (Combat Control, Acoustics, Communications, ESM, Ship Control, Photonics Periscope). The end item product would be a specification adequate to support competitive procurement of a low cost (maximum of $200K each) universal display console.

PHASE II: Phase II would involve utilization of the procurement specification to procure one display console and perform a demonstration showing the console meets the specified interface requirements.

N93-076 TITLE: Passive Automation

CATEGORY: Advanced Development

OBJECTIVE: Develop data fusion techniques that will automate the detection and classification processes for acoustics.

DESCRIPTION: The shallow water, high noise environment that the sonar operator must deal with presents a very complex problem. The detection and classification processes must be automated to the extent possible in order to reduce this complexity and allow for reduced manning of existing and future acoustic systems. This project will focus incorporating non-traditional signal processing techniques into the association and correlation of target parameters to improve detection performance and minimize the false alarm rate. The resulting algorithms will be validated against recorded sea data.

PHASE I: Identify candidate non-traditional signal processing data to be incorporated into the passive automation algorithms and recommend techniques for including this data in the automated detection and classification algorithms.

PHASE II: Prototype the algorithms and validate performance against recorded sea data.

N93-077 TITLE: Supportability of Commercial-Off-The-Shelf (COTS) Products in Military Systems.

CATEGORY: Advanced Development

OBJECTIVE: This project will address potential techniques for the support of commercial products in military systems and highlight those techniques that will provide the lowest cost, "best-value", life cycle support for those products.

DESCRIPTION: With the thrust of lower cost military systems comes significant emphasis on the use of COTS products for the implementation of those systems. There are two (2) key issues associated with the use of COTS products in military systems. (1) Know performance limitations, and (2) Life Cycle Support. Relative to known performance limitations, commercial software

products do not typically identify known limitations of "glitches". If these products are used in weapon targeting systems how can the Navy be assured that these limitations do not impact the performance of the system or the delivery of the weapon on target? How will software documentation be affected and what is the impact on standards such as MIL-STD-2167A? This project will address techniques and tools required to ensure performance and maintainability while maximizing the cost benefit of COTS. Relative to life cycle support, military systems have a typical life expectancy of twenty years or more while commercial products have a life cycle of 5 years or less. Various techniques for supporting the longer life cycle will be evaluated. An evaluation of these techniques will include cost modeling to determine the best technique for maximizing the cost advantages of COTS hardware.

PHASE I: Identify techniques and tools required to ensure performance, maintainability and acceptable life cycle cost for COTS implementations.

PHASE II: Using the candidate techniques and tools identified in Phase I, evaluate each of these techniques to show which are most cost effective. Compare with existing system implementation to show the overall cost advantage of commercial implementations.

N93-078 TITLE: Utilization of High Resolution Color Displays for Sonar Data

CATEGORY: Advanced Development

OBJECTIVE: Reduce operator workload and improve operator response time through the use of high resolution color displays for acoustics.

DESCRIPTION: High resolution displays (i.e. 2048 x 1538 pixels) as well as multiple colors allow sonar data to be presented in ways not possible in today's systems. This project will address innovative display techniques for the presentation of acoustic data that will make it easier for the operator to understand the information being presented. For example, color can be used as a third dimension and relate additional information to the operator to understand the information being presented. For example, color can be used as a third dimension and relate additional information to the operator such as bearing rate. This technique has been shown to improve near MDL detections by as much as 2-3 Db. Other techniques such as quantizing to 256 grey shades instead of 8 make a significant difference in the operators ability to discern subtle patterns in the gran. data. These techniques in addition to those needed to present top-level summary data will be evaluated as a part of this project.

PHASE I: Develop and demonstrate display enhancement techniques for acoustic data

PHASE II: Prototype the techniques recommended in Phase I using Commercial-Off-The-Shelf hardware and demonstrate using recorded sea data.

N93-079 TITLE: High Frequency (HF) Skywave Recognition Using Small Baseline Antenna Arrays

CATEGORY: Exploratory Development

OBJECTIVE: To develop techniques to automatically differentiate, in "real time", HF (1 to 30 Mhz) signals that are propagating by pure groundwave.

DESCRIPTION: In some Naval scenarios it is valuable to be able to rapidly identify signals that are being transmitted from locations within the area of tactical interest. In case of HF transmissions, those signals that are propagating by other than direct groundwave can often be considered to be beyond the area of tactical interest. Additionally, the performance of some direction finding antenna arrays is degraded by signals arriving from high elevation angles with rotating polarization resulting from reflection off of the E-Layer. For these reasons it would be useful to be able to identify these skywave signals as they are received by the on board antennas. These antennas are generally less than 16 inches in diameter.

PHASE I: Develop a technical approach for the automated recognition of received HF signals propagated by a skywave path. This includes the analysis of the electromagnetic propagation mechanism and effects on the received signal characteristics. Define the receiving antenna and receiver characteristics required to process the signal and describe and processing algorithms that must be developed. Show how existing submarine antenna types used in this frequency range can be used to provide this capability. Provide a detailed technical report describing the study results.

PHASE II: Design and construct a set of equipment to demonstrate the skywave recognition capability. This equipment must be suitable for use with existing submarine antennas or with modifications of these antennas. Demonstrate the performance of the equipment at a land-based site and subsequently install the equipment onboard a submarine for a test demonstration underway at sea.

N93-080 TITLE: Knowledge Based Processing as Applied to Reduced Manning

CATEGORY: Research

OBJECTIVE: To develop knowledge based applications that can be incorporated on submarines to reduce the manpower requirements for submarine operations.

DESCRIPTION: Since future submarines will require reduced manning in order to reduce slip size and operating costs, knowledge based applications that can be incorporated on submarines to reduce manpower requirements are needed. Multiple applications which are currently performed on submarines require human operators. Several of these applications are candidates for incorporation of knowledge based processing.

PHASE I: Investigate the feasibility of incorporating expert systems into submarines systems to reduce the number of manned watch stations. This investigation will include combat systems (CS), non-propulsion electronics (NPE) and Hull Mechanical and Electrical (HM&E) systems. A report will be the product of this initial phase.

PHASE II: Prototype and demonstrate up to 3 applications of knowledge based systems reported in Phase I.

NAVAL SURFACE WARFARE CENTER/DAHLGREN

N93-081 TITLE: Low Cost Miniature G-Hardened Inertial Navigation Sensor (INS) for Gun Launched Projectiles

CATEGORY: Exploratory Development

OBJECTIVE: Develop a miniature, low cost, gun launchable, three axis inertial measurement sensor.

DESCRIPTION: This SBIR topic seeks to develop a miniature INS which can be packaged within a 60mm projectile with a cylindrical interior volume 40 to 50mm in diameter not exceeding 50mm in length including all signal conditioning and I/O but exclusive of power source. The unit shall be capable of surviving and operating within specification after the application of at least 30,000 Gs of set back acceleration normal to the cylindrical face of the packaging volume. Lateral and set forward accelerations shall be 3,000 and 10,000 Gs, respectively. This INS configuration is intended as a sensor suite for an autopilot or airframe stability augmentation system. Performance specifications for the INS shall be developed by the contractor and should be applicable to a variety of missile and projectile systems. The INS does not have to operate before or during gun launch acceleration, however, the unit should be ready to operate in < 0.3 sec after the application of power. The INS shall also be insensitive to temperature variations and operate in a reliable fashion for at least 30 seconds. Production cost goal for 5,000 units is $3,000.

Alternative Configuration: An alternative packaging scheme will be for a 127mm (5") or 120mm projectile in which the cylindrical interior volume available for packaging will be 4.3 to 4.6 inches in diameter and less than 2.0 inches in length including all signal conditioning and I/O but exclusive of power source. This INS configuration is intended as a sensor suite for an inertial navigation system. Drift rate performance specifications for this INS configuration shall be < 1.0 nautical miles per hour (< 0.5 desirable) and < 10 degrees per hour (< 5 desirable). It may be assumed that the static offsets of the INS accelerometers and rate sensors can be effectively removed by an external and independent inertial reference system such as GPS. Other performance specifications shall be developed by the contractor and should be applicable to a variety of missile and projectile systems. The INS does not have to operate before or during gun launch acceleration, however, the unit should be ready to operate in < 2.0 sec after the application of power. The INS shall also be insensitive to temperature variations and operate in a reliable fashion for at least 5 minutes. Production cost goal for 5,000 units is $3,000.

PHASE I: A final report describing theory of operation, estimated performance, technical risks and a proposed phase II and phase III statement of work.

PHASE II: Hardware demonstrations and other technical documents which verify predicted performance both before and after gun shock tests. Hardware may be "brassboard" (not necessarily form and fit) in areas of the design which are not affected by component size, mass, electrical configuration or packaging.

PHASE III: Navy funding - to demonstrate form, fit and function hardware performing as predicted and specified in the Phase I study portion of this program - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

COMMERCIAL POTENTIAL: Exists in the automotive and oil industry.

N93-082 TITLE: Long-Life Lithium Thermal Battery Technology

CATEGORY: Exploratory Development

OBJECTIVE: To develop high energy, long life, thermal batteries.

DESCRIPTION: Current ASW Surveillance Systems are emitted by the low power capabilities of their batteries. The objective of this topic is to develop lithium thermal batteries capable of delivering as succession of high power pulses over a period of 60 minutes. Clearly, significant advance battery lifetimes are called for.

PHASE I: Will evaluate transition metal compounds for alternative cathodes. Cathode materials are needed with capacities in excess of 0.2 Ah/g and are much more thermally stable than iron disulfide. Ideal candidates would be nontoxic and also have higher discharge voltage than iron disulfide. Tests will be done in single cells.

PHASE II: The best cathode will be evaluated in small 20 cell batteries and practical cells will be built and tested to verify the safe delivery of high power densities.

PHASE III: The results of Phase II will transition into the office of Naval Technology's High Energy Battery Project of the NS3B Block for further development. Follow-on effort to be negotiated as a Task under the Naval Surface Warfare Center's Mines Technology Area Block Program, SD3B.

COMMERCIAL POTENTIAL: Exists for portable electric welders.

N93-083 TITLE: Energetic Phosphazene Polymers

CATEGORY: Exploratory Development

OBJECTIVE: Research and development of synthesis pathways to organic phosphites containing energetic groups, as precursors for the development of energetic phosphazene polymers.

DESCRIPTION: Polyphosphazenes are inorganic macromolecules containing a flexible backbone of altnerating P-N atoms. The properties of the polymer can be controlled or altered by varying the nature of the substituents attached to the phosphorus atoms in the polymers chain. An entirely new class of energetic phosphazene polymers should be capable of synthesis in which the substituents are nitroalkoxy groups. These polyphosphazenes may have great potential to exhibit a wide range of unique chemical and physical properties and superior performance-sensitivity characteristics compared to conventional (C-C or C-N backbone) polymers.

PHASE I: This research will develop synthetic methods for the preparation of phosphites containing energetic alkocy substituents such as fluorodinitroethoxy, 2, 2-dinitropropoxy and 2, 2, 2-trinitroethoxy. These compounds will be fully characterized by chemical and physical properties and superior performance-sensitivity characteristics compared to conventional (C-C or C-N backbone) polymers.

PHASE II: The Phase II plans of the research and development effort will address the large scale preparation of selected compounds prepared in Phase I. Additional basic research and development work will be required to maximize synthetic efficiency for selected target compounds. Sufficient material should be synthesized and forwarded to the Naval Surface Warfare Center, Dahlgren Division, for larger scale preparation of polyphosphazene polymers for energetic performance evaluations.

PHASE III: Anticipated Phase III transitions are the investigation of these polymers as energetic plasticizers, binders in PBXs, melt cast explosives and homogeneous insensitive explosives comparable to RDX and HMX. Follow-on effort to be negotiated as a Task under Naval Surface Warfare Center Dahlgren Divisions Explosives and Undersea Warheads Technology Area Block Program, SD3A.

COMMERCIAL POTENTIAL: Exists in energetic materials, explosives and propellents.

N93-084 TITLE: Near-Real-Time Data Fusion

CATEGORY: Exploratory Development

OBJECTIVE: Development of a tactical decision aid for employment of weapon system resources.

DESCRIPTION: In the world of the future, the Navy may be faced with surreptitious attacks, possibly coordinated, in a situation of undeclared war, or terrorism. The locale of the future is likely to be littoral. This environment stresses both the

reaction time of weapons systems and the performance of sensors such as radar and infrared sensors. Threats may be masked by terrain, camouflage, or ECM. Threats may include missiles, aircraft, and tactical ballistic missiles. Additionally, the number and capability of onboard and offboard sensors is growing. Also, the options for countering these threats are increasing. Additionally, tactical databases are becoming larger and more readily accessible. To prevent saturating tactical decision makers, the Navy must rapidly fuse available data. It is desired that a near-real-time data fusion (NDF) system prototype tactical decision aid for employment of weapon system resources be developed and evaluated. Among the many variables this system must consider are the threat environment, operation of sensors and weapons in their natural environment against these threats, and the ship's location relative to threats.

PHASE I: The proposed system design approach including data inputs and outputs, equipment, computer program functions, operator interactions, networks, data flows and databases should be documented. At least one of the critical issues should be demonstrated in a prototype or model to be delivered upon completion of Phase I.

PHASE II: One system will be prototyped in its entirety and be evaluated in a laboratory environment.

PHASE III: Navy funding is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results obtained.

COMMERCIAL POTENTIAL: Exists in the aircraft communications industry.

N93-085 TITLE: Improved Underwater Target Identification Through Optical Processing

CATEGORY: Exploratory Development

OBJECTIVE: Develop a high speed multichannel optical correlator for onboard sonar range-doppler processing of suspected underwater targets.

DESCRIPTION: The search for underwater targets with sonar results in a difficult data analysis problem to detect and identify moving targets in the presence of extraneous noise (clutter). Modern optical technology offers a way to significantly improve processing gain in both active and passive sonar systems. A parallel optical correlator will use light sources, detector arrays and storage media in time integrated correlation to produce processing gains on the order of 50 Db without the use of lasers or other methods of optical interference. A simple system would use either moving film or a rotating disk (or cylinder) to transmit target reference signals through an illuminated aperture. These signals are correlated with the light source modulated by signal data. Extremely reliable, compacts low cost and low power signal processing correlation should be possible by combining existing optical components. A system capable of 50 db processing gain in 1000 or greater parallel channels (at least 1000 points of each correlogram computed in parallel) is desired, signal conditioning techniques to enhance processor performance should be included.

PHASE I: Provide an optical correlator design which includes synchronization with existing sonar signal processing systems.

PHASE II: Build and test a breadboard optical processor based on the Phase I design. Deliverables should include a design analysis, a design documentation package and the breadboard processor.

PHASE III: Navy funding - to transition this work to further develop the prototype for use in existing or future antisubmarine warfare systems - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results obtained.

COMMERCIAL POTENTIAL: Exists in oil exploration, undersea salvage and medical imaging industry.

N93-086 TITLE: Safe, High Performance Rechargeable Batteries for Underwater Vehicle Propulsion

CATEGORY: Exploratory Development

OBJECTIVE: To develop safe, high performance rechargeable batteries for underwater vehicle propulsion.

DESCRIPTION: The Navy is developing a high energy, rechargeable lithium battery that will significantly extend the capabilities of naval underwater vehicles, such as the SEAL delivery vehicle. The lithium/cobalt oxide ($Li/LixCo0_2$) electrochemical couple has been successfully demonstrated in 30 Ah capacity, hermetic cells. When compared to 30 Ah silver oxide/zinc (Ag0/Zn) cells, the lithium cells gave more charge-discharge cycles with 40-50% greater energy density. Although $Li/LixCo0_2$ out performed the Ag0/Zn technology, its cycle life was limited by the formation of dendritic shorts when charging the lithium electrode. If the metallic lithium anode were replaced with a carbonaceous lithium ion electrode, significant

improvements in cycle life might be attainable. It is anticipated, furthermore, that this system would also be safer since it reduces the I^2R heating caused by dendritic shorts.

PHASE I: Identify carbon anode materials that offer significant improvements in specific capacity over petroleum coke. The anode will be optimized for high rate capabilities, cycle life and energy density. Using data obtained from the Navy's 30 Ah $Li/LixCo0_2$ study, the energy densities of 30 and 400 Ah lithium ion/cobalt oxide cells will be projected.

PHASE II: The optimized anode identified in Phase I will be coupled with the cobalt oxide cathode. Small hermetic cells will be built and tested to verify the safety and performance of this system. Using these results, in combination with the ongoing $Li/LixCo0_2$ data, new projections will be made for a 30 and 400 Ah cell.

PHASE III: Navy funding - to transition into Office of Naval Technology's High Energy Battery Project (NS3B) for further development - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results obtained.

COMMERCIAL POTENTIAL: Exists for electric vehicles.

N93-087 TITLE: Refractory Diboride Composites

CATEGORY: Exploratory Development

OBJECTIVE: Develop a processing approach for a near theoretical density continuous fiber diboride/diboride composite.

DESCRIPTION: Diboride materials (of Zr and Hf) were investigated in the 1960's and were found to be highly ablation-resistant to oxidizing propellants. However, the thermal stress resistance of the monolithic materials was not satisfactory. Continuous fiber composite materials are attractive for very high temperature applications, such as rocket nozzles and reentry body leading edges, due to the possibility of incorporating high-strength fibers to eliminate brittle failure and, thus, improving thermal stress resistance. With current investigations underway to develop diboride fibers for intermetallic matrix composites, a process is needed to infiltrate and densify a diboride fiber preform with a diboride matrix.

PHASE I: Effort should provide evidence that the desired composite fabrication is possible. Ideally, analyses should be performed to show the feasibility of the approach and key experiments performed for verification. Process should allow for minor variation in matrix composition to provide augmented strength, oxidation resistance, etc. In addition, control of fiber/matrix interface characteristics is required and means for such control should be provided.

PHASE II: Effort would identify composition variations and respective processing parameters for improved strength or oxidation resistance, produce simple composite geometries, and provide mechanical and oxidation property data to show that scale-up to full-size components is warranted in Phase III.

PHASE III: Follow-on effort to be negotiated as a Task under the Naval Surface Warfare Center, Dahlgren Division's Weapons and Spacecraft Materials Technology Area Block Program, SD2A.

COMMERCIAL POTENTIAL: Exists in the satellite industry.

N93-088 TITLE: Low-Earth Orbit Environment

CATEGORY: Exploratory Development

OBJECTIVE: Design and construct a laboratory facility which simulates the atomic oxygen environment of spacecraft in low-earth orbit.

DESCRIPTION: Currently there are few facilities capable of simulating the corrosive environment which atomic oxygen has on materials in low-earth orbit. A facility is sought which contains an ion source capable of producing a low energy atomic oxygen beam for irradiating samples in a vacuum chamber. Capabilities of this facility include:

Beam Energy Range	-	2 - 10 ev/atom
Minimum Neutral Oxygen Atom Fluences	-	5 x 10 (15) atoms/cm(2) - sec
Contaminant Level (incl. molecular Oxygen, ionized oxygen, ozone, nitrogen and other gases)	-	<0.1%
Uniformly Irradiated Sample Size	-	1 - 10 xm (diameter)

PHASE I: Provide a facility design with a procedure for verifying the purity, energy, and fluence of the source device.

PHASE II: Construct, characterize and deliver a complete facility capable of evaluating spacecraft materials lifetime and survivability in low-earth orbit.

PHASE III: Follow-on effort to be negotiated as a Task under the Naval Surface Warfare Center, Dahlgren Division's Weapons and Spacecraft Materials Technology Area Block Program, SD2A.

COMMERCIAL POTENTIAL: Exists in communication satellites

N93-089 TITLE: System Dependability Assessment Methodology

CATEGORY: Exploratory Development

OBJECTIVE: This research will develop a methodology and prototype to assist the system designer in quantifying trade-offs between dependability and other system attributes such as performance, cost, size, weight, power, and security.

DESCRIPTION: One of the crucial requirements of Navy systems is that they must be able to perform critical functions within specified real-time deadlines in stress situations. Systems which are not built on fault tolerant structures cannot handle faults without temporary loss of critical functionality. The purpose of this research is to develop concepts and technologies related to dependability, and provide a prototype to assist the designer in quantifying trade-offs between dependability and other system attributes such as performance, cost, size, weight, power, and security. The prototype will permit analysis of the impact of candidate fault tolerant structures on the system's design and implementation. Fault avoidance, fault tolerance, adaptability, and graceful degradation are important considerations.

The dependable system design prototype may serve as a proof of concept vehicle for concepts and technologies related to dependability, or it may serve as a testbed for research on the integration of dependability automation support into the systems engineering process.

PHASE I: Work should show feasibility. The proposed methodology should be documented in an initial methodology report. The requirements and design of the prototype should be defined by the end of Phase I. Any critical risk areas of the design should be prototyped to show feasibility of the total approach.

PHASE II: Work should include the full scale development of the dependable system design prototype. Usefulness of the method and prototype should be demonstrated on a sample test case to facilitate transition of the products of the work into Navy systems development. The initial method report should be updated to incorporate Phase II research and any lessons learned during the development of the prototype.

PHASE III: Follow-on effort to be negotiated as a Task under Naval Surface Warfare Center Dahlgren Division's Engineering of Complex Systems Technology Area Block Program, SD2C.

COMMERCIAL POTENTIAL: Exists in various areas, such as commercial avionics, nuclear systems and telecommunication systems.

N93-090 TITLE: High Speed Optical Processing for Antisubmarine Warfare

CATEGORY: Exploratory Development

OBJECTIVE: To exploit optical connectivity and the inherent high processing capabilities of optical signal processing and computational systems in order to satisfy the high speed detection and classification requirements of future antisubmarine warfare surveillance systems.

DESCRIPTION: The growth in the information processing demands of advanced antisubmarine warfare surveillance systems is outpacing the improvements in conventional electronic processing technology. For example, there is a square law relationship between sensitivity improvement versus number of passive sonar sensors versus computational power. Computational rates up to 10 to the fourteenth operations per second may be needed to satisfy future demands. Advanced optical signal processing and computing systems, exploiting emerging photonic materials and devices, can have enormous advantages over conventional electronic systems in terms of data throughput and speed. These advantages can be applied to a multiplicity of problems associated with antisubmarine warfare including wideband passive sensor data processing and Low Frequency Analyzing and Recording (LOFAR) analysis for detection, classification and tracking and reducing operator overload.

PHASE I: Develop the theory, concept, specifications and architectural description for a high speed optical processing or computing system for passive sonar signal conditioning, data processing and analysis. Provide detailed technical report.

PHASE II: Design, develop, demonstrate and deliver a working prototype optical processing system for passive sonar data processing and analysis. The system can be packaged as an optical breadboard in rackmount or air transport case size subunits, but must be easily transportable and must be capable of operating on actual sonar data stored on tape or magnetic disk.

COMMERCIAL POTENTIAL: Exists in spectrum analysis and voice recognition.

N93-091 TITLE: Real-time Optical Synthetic Aperture Radar Signal Processing

CATEGORY: Exploratory Development

OBJECTIVE: To develop and demonstrate a real-time optical synthetic aperture radar processor for automatic target recognition.

DESCRIPTION: Optical signal processing has enormous advantages over conventional synthetic aperture radar (SAR) signal processing in terms of data throughput and speed. These advantage can be applied to identifying targets from background scenery. The radar processing system could store information on all aspects of the target in a data bank in the form of templates for high speed pattern matching. The system could be both programmable and adaptive to changing parameters at the SAR input plane. The required SAR image scan rate should be greater than 2000 frames per second and the total system processing time, from radar return to output should be within a few seconds. New and novel optical processing architectures are sought which utilize advanced optical devices and techniques, such as spatial light modulators, two dimensional microlaser diode arrays, holography and high speed photodetectors. Dynamic range, compactness, power consumption and flexibility are also important considerations.

PHASE I: Development of theory, algorithm, architecture, proof of concept modeling and limited demonstration of key concepts.

PHASE II: Design, test, demonstration and delivery of prototype SAR image processing system.

PHASE III: Follow-on effort to be negotiated as a Task under Surface Launched Weaponry Technology Area Block Program, SDIA.

COMMERCIAL POTENTIAL: Exists in search and rescue operations.

N93-092 TITLE: Coatings for Diamond Films Used on High Speed Missiles

CATEGORY: Exploratory Development

OBJECTIVE: Identify an oxidation-resistant coating and a procedure for applying it to diamond films which are proposed for use over the infrared windows and radomes of hypersonic missiles.

DESCRIPTION: The unique combination of mechanical, thermal and optical properties of diamond make it extremely attractive as a protective film material for infrared windows and radomes. However, in these applications the diamond films will be subjected to elevated temperatures in an oxidizing atmosphere which may cause a catastrophic erosion of the film. An oxidizing resistant coating is sought along with a practical technique for applying it to Chemical Vapor Deposition (CVD) applied diamond films. These coatings should possess excellent oxidation resistance at temperatures up to 1573°K, have high erosion resistance, excellent adhesion, and be transparent to infrared and radar frequencies.

PHASE I: Identify a suitable oxidation resistant coating and specify the procedure for applying it to a diamond film which overlays a missile window or radome.

PHASE II: Develop the procedure for coating diamond films and provide coated samples for evaluation.

COMMERCIAL POTENTIAL: Exists in the aerospace industry.

N93-093 TITLE: Optical Postprocessing Module for Improved Underwater Target Identification

CATEGORY: Exploratory Development

OBJECTIVE: Develop an optical processing module which acts as an interface between a future optical processor for underwater sonar signal processing and on-board tactical computers.

DESCRIPTION: Future optical processors for underwater signal processing systems will need to be integrated to an optical

postprocessing module for efficient operation. This module will contain a Charge Coupled Device (CCD) detector to convert the output of an optical processor into a format which is useful to tactical computers. The module must correct for optical irregularities in illumination, pixel gain, offset nonuniformities due to dark currents and possible contaminants. Also clutter rejections or multispectral tests may need to be performed as well as baseline normalization, edge detection, pixel averaging or other convolution-type functions. In order to perform data reduction, the module should be able to supply the external processor with the addresses and values of individual pixel elements.

PHASE I: A PC board, hybrid or multichip module will be designed which performs the functions of a 12 bit frame grabber and image processing board. The module will be capable of digitizing, storing, summing and otherwise processing the data from a large pixel density CCD array. It is envisioned that a module will have the capability of storing at least 4 full frames of 10-3 x 10-3 array or larger with the goal of 64 frames. Real time arithmetic processing is also a major goal. In addition, the CCD array support signals and buffering such as the power lines, pixel clocks and integration and reset pulses etcetera will be supplied by the module. The module will have CMOS compatible I/O for exposure and frame timing, pixel clock, programming, data, etc. Designs and design alternatives will be deliverable as a final report.

PHASE II: Definition and Deliverables: A large area CCD array of at least 10-3 x 10-3 pixels will be integrated into a compact processor module which performs the above functions. A complete processor and documentation package will be deliverable items.

PHASE III: This module would make a major contribution to inserting advanced optical signal processing technology into the fleet. A strong possibility exists that several ASW programs would consider using this module to support whatever optical processing technology their particular program used.

COMMERCIAL POTENTIAL: Exists in the oil exploration, undersea salvage, or medical imaging industry.

N93-094 TITLE: Process Development for a New Oxidizer for Navy Missile Propellants

CATEGORY: Exploratory Development

OBJECTIVE: To develop a cost-effective method for the isolation of pure nitrogen pentoxide(N2O5) from its solution in nitri acid.

DESCRIPTION: A new candidate propellant oxidizer, ammonium dinitramide (ADN), for low signature propellants has been identified by the Navy. ADN has several advantages over the current oxidizer (Ammonium perchlorate or AP): (1) ADN allows melt-casting of the propellant grain, reducing the cost of the propellant grain and permitting closer control of composition; (2) propellants based on ADN will have a reduced signature and environmental impact because hydrogen chloride is not a combustion product. Further, theoretical calculations show that replacing AP with ADN does not reduce the specific impulse of the propellant.

In order to evaluate ADN-based propellant compositions, the cost of ADN must be significantly reduced. This can be accomplished if we can develop an efficient method to make pure, acid-free N2O5(required in the last step of ADN production).

PHASE I: A fundamental study of separation technologies will be applied to the N2O5/HNO3 system. Low-cost methods such as extraction, membrane diffusion, and phase separation should be explored. The final report shall document the cost, efficiency, operating parameters, product purity, and processing time.

PHASE II: The most promising separation technology identified in the Phase I study will be further refined to minimize cost and maximize N2O5 purity, and then scaled-up to a fully automated prototype system capable of producing ten pounds of pure, acid-free N2O5 per day. The final report shall include a detailed engineering package for the prototype system and typical data records generated during and after prototype development.

COMMERCIAL POTENTIAL: Exists in the pharmaceutical industry.

N93-095 TITLE: Miniature, G-Hardened, Fast Acquisition GPS Inertial Navigation Sensor (GPS/INS)

CATEGORY: Exploratory Development

OBJECTIVE: Develop a miniature, gun launched, fast acquisition, 5 channel GPS receiver and antenna system which can be packaged in a 5 inch or 120mm projectile.

DESCRIPTION: This SBIR topic seeks to develop gun launchable, fast acquisition, GPS inertial navigation sensor with five

or more channel which can be packaged in < = 2 inches of body length within the interior dimensions of a 5 inch or 120mm projectile exclusive of power source. The GPS/INS shall be capable of a first navigational fix within 2 seconds after the application of power in a non-jamming environment. Time to first fix shall be allowed to degrade as the jamming environment worsens. The GPS/INS shall have the capability to process information from an Inertial Navigation Sensor (INS) via a navigation and attitude control computer (NAC) which shall be capable of total flight management of the airframe including event sequencing, autopilot functions, navigation & guidance, and fuzing.

The GPS/INS shall include a GPS receiver antenna array (GPS/RxA) which will allow the projectile to maintain a continuous GPS track of at least four satellites (5 preferred) while flying a nominal trajectory. It may be assumed that roll control of the projectile body may be used to point or orient the GPS antennae to facilitate the maintenance of satellite tracks, Other antenna requirements shall be, (1) antennae array(s) may be placed conformally around the projectile body but shall not consume more than 4 inches along the projectile body length, (2) regardless of the azimuth of the trajectory, satellite track shall be maintained while the projectile body changes its angular position In the vertical plane from 60 degrees above the local horizontal to 60 degrees below it at a steady (low-frequency) rate not exceeding 2.5 degrees per second, (3) the antennae system shall maintain satellite track while the projectile body is experiencing high frequency pitch-yaw body oscillations due to guidance, ≤ 3Hz with amplitudes not exceeding 5 degrees.

The entire GPS/INS shall be capable of surviving and operating within specification after the application of at least 30,000 Gs of set back acceleration normal to the cylindrical face of the packaging volume. Lateral and set forward accelerations shall be 3,000 and 10,000 Gs, respectively. The GPS/INS shall also be insensitive to temperature variations and operate in a reliable fashion for at least 5 minutes. Production cost goal for 5,000 units is $3,500.

PHASE I: A final report describing theory of operation, estimated performance, technical risks and a proposed phase II and phase III statement of work.

PHASE II: Hardware demonstrations and other technical documents which verify predicted performance both before and after gun shook tests, Hardware may be "brassboard" (not necessarily form and fit) in areas of the design which are not affected by component size, mass, electrical configuration or packaging.

PHASE III: Navy funding - to demonstrate form, fit and function hardware performing as predicted and specified in the Phase I study portion of this program - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

COMMERCIAL POTENTIAL: Exists in the automobile industry.

N93-096 TITLE: Low Cost Control System Components for Gun Launched Projectiles

CATEGORY: Exploratory Development

OBJECTIVE: Design/develop Miniature Modular G-Hardened High Torque Motors and Gear Reduction Components (HTM & GRC)for use in conjenction with a low cost, gun launched, dual mode inertial navigation unit, (DMINU).

DESCRIPTION: This SBIR topic seeks to develop gun-launchable, high-torque motor and gear reduction assemblies which will be used to deflect aerodynamic control surfaces on a wide variety of projectile and small missile configurations. The smallest volume constraint will be a single-axis configuration (one plane of control) for a 60mm projectile with a cylindrical interior volume 40 to 50mm in diameter not exceeding 100mm in length including the control shaft, gear reductions, control and power conditioning circuitry and I/O but exclusive of power source. The largest projectile and missile systems to be considered for these components will be approximately 155mm or 6 inches. Components shall be capable of surviving and operating within specification after the application of at least 30,000 Gs of set back acceleration normal to the cylindrical face of the packaging volume. Lateral and set forward accelerations shall be 3,000 and 10,000 Gs, respectively. It is highly desirable that a single high-torque, high-speed motor be capable of supporting a wide variety of control system configurations and performance requirements via multiple motors and a wide range of gear reduction ratios which cover at least one order of magnitude (ex: 10:1 to 100:1). The objective is to trade shaft speed for shaft torque and vice versa as dictated by individual applications. The more complex two-axis (pitch-yaw control) and three-axis (pitch-yaw-roll control) systems are to be constructed by the addition of motor, shaft and gear reduction assemblies. Circuitry containing control, power conditioning and I/O electronics may also be modular in design. Specifications for the smallest projectile application (60mm) is provided below as a point of departure:

Max. Control Deflection	≤ 15 degrees
Max. Airframe Roll Rate	≤ 30 Hz
Max. Control Shaft Rate	≥ 3000 degrees per second
Aero Control Torque Slope	≤ 5 oz-in per degree

Control Section Bandwidth	≥ 40 Hz
Damping	≥ 70% Critically Damped
Repeatability	≤ 1% Full Scale
Resolution	≤ 1% Full Scale
Absolute Accuracy	≤ 3% Full Scale
Production Cost (5,000 units)	≤ $2,000

PHASE I: A final report describing theory of operation, estimated performance, technical risks and a proposed phase II and phase III statement of work.

PHASE II: Hardware demonstrations and other technical documents which verify predicted performance both before and after gun shock tests. Hardware may be "brassboard" (not necessarily form and fit) in areas of the design which are not affected by component size, mass, electrical configuration or packaging.

PHASE III: Demonstrate form, fit and function hardware performing as predicted and specified in the Phase I study portion of this program - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

COMMERCIAL POTENTIAL: Exists in the automobile and robotics industries.

N93-097 TITLE: Multimode FEL Based Tracking Sensor

CATEGORY: Exploratory Development

OBJECTIVE: Adaptation of THOR Accelerator for Coherent IR Emission

DESCRIPTION: THOR is a long pulse electron accelerator located at NSWC/WO which produces a 1 microsecond, 1-2 kA pulse of electrons in the 2.5 to 3.0 MeV energy range. Recent studies indicate this apparatus has the capability to simultaneously generate high quality coherent mm and IR radiation. Demonstration of this capability would be the predecessor of a "quantum improvement" in tracker performance in the mm and IR regions. It may also lead to an important advance in EW capability.

PHASE I: A feasibility study and preliminary design for modifying THOR to provide IR emissions is the main goal. The preferred approach is to use the system as an oscillator to take advantage of the continuous tuning capability of a FEL. However, consideration of a fallback configuration where the system is used as an amplifier is also appropriate. It would also be desirable to provide an estimate of the expected beam quality.

PHASE II: Hardware implementation of the designs and results of the Phase I program. Any modifications to THOR for generating IR must be compatible with similar modifications for the production of mm waves. The contractor will thus have to closely coordinate work with personnel at NSWC to ensure this compatibility.

PHASE III: Navy funding - in conjunction with the ElectroThermal gun program - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

COMMERCIAL POTENTIAL: Exists in environmental monitoring.

N93-098 TITLE: Self Adjusting Obturator

CATEGORY: Gun Round Improvement

OBJECTIVE: Provide self adjusting obturator seal to accommodate barrel wear in smooth bore advanced gun, firing guided projectiles.

DESCRIPTION: Barrel wear allows blow by of breech gases because the seal of the back pressure plate, or obturator, no longer has adequate squeeze pressure against bore wall. A self adjusting obturator located between cartridge case and the rear of the projectile is needed to improve the life of smooth bore gun barrels. Pressure plate thickness must accommodate 5" projectile dimensions, withstand 30,000 g accelerations, pressures up to 55,000 psi, temperatures of 400°C and bore wear of 0.25" or more.

PHASE I: An obturator solution is needed which will accommodate barrel wear such that the life of a future 5" advanced gun barrel can be extended. A design(s) with description of how it works and sufficient analysis is needed to select an approach(es) for Phase II implementation. A plan for Phase II is required.

PHASE II: A laboratory demonstration (could be conducted at a government test facility), of a sufficient number of

samples of the selected design, will be the culmination of Phase II.

PHASE III: Navy funding - to field test, using a 5" smooth bore gun, following successful laboratory demonstration - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

COMMERCIAL POTENTIAL: Exists in industries where self adjusting mechanisms are required.

N93-099 TITLE: Instrument for In-Situ Measurements of Special Hull Treatments

CATEGORY: Advanced Development

OBJECTIVE: Develop an instrument to provide real-time in-situ dynamic modulus and state of cure measurements of special hull materials based on an existing laboratory prototype.

DESCRIPTION: The trend towards mold-in-place installations of special hull materials requires that in-situ techniques be developed to insure good quality control of installation. Visual inspections and shore hardness tests are available but no instrument exists to provide the in-situ dynamic modulus measurements which are critical to performance. Measurements of the state of cure are desirable since cure time depends on cure mixture ratio. The Naval Surface Warfare Center has developed a laboratory prototype instrument which can provide dynamic Young's modulus and state of cure measurements of a polymeric system. (Specifications are provided in the reference). This laboratory device needs further development for providing measurements at Navy mold-in-place installations. Specifically, the prototype needs modification and theory development for data reduction to measure thin coatings applied to rigid hull material.

PHASE I: Design a dynamic hardness tester and cure meter based on an extension of the Government prototype for in-situ measurements. Design should include the necessary theory development for data reduction.

PHASE II: Build a commercial prototype instrument based on the Phase I design. Participate in testing instrument at a Navy special hull treatment facility. Provide design documentation and a user's manual.

COMMERCIAL POTENTIAL: Exists in the metal, plastic, rubber and polymeric industries.

N93-100 TITLE: Rapid Detection Methods for Biocorrosion

CATEGORY: Exploratory Development

OBJECTIVE: To develop a rapid method for early detection of microbiologically influenced corrosion occurring in Naval seawater piping systems.

DESCRIPTION: Laboratory and field studies, as well as ship corrosion surveys, indicate that microbiologically influenced corrosion (MIC) may be a significant hazard to shipboard seawater piping and heat exchanger systems. Failures have largely been attributed to the action of sulfate-reducing bacteria, but other microorganisms also may be involved. MIC of these systems generally is not detected until failure of the materials occurs. Methods are sought which will detect MIC in shipboard systems before major damage occurs so that preventive treatments can be implemented.

PHASE I: The Phase I product will be the feasibility demonstration of a novel method for rapid detection of MIC.

PHASE II: Navy funding - to develop and test the method for in situ monitoring or periodic testing of shipboard piping and heat exchanger systems - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results obtained.

PHASE III: A Navy-funded Phase III effort is anticipated if a useful detection system is provided in Phase II.

COMMERCIAL POTENTIAL: Exists in the electric power or any industry using seawater piping or seawater coolant in heat exchangers.

N93-101 TITLE: Formulation of Method to Integrate Design Views

CATEGORY: Exploratory Development

OBJECTIVE: This research will develop a methodology and toolset for interchanging and transitioning between alternative

system design techniques.

DESCRIPTION: Navy system architectures today are very large scale, complex, and require real time processing. To minimize the cost in the design stage of such a system, a complete detailed analysis needs to be performed. Current methodologies that were used to capture and analyze systems are very divergent and incomplete in terms of supporting today's Navy systems. Because each methodology only tends to cover one specific view of the system, there is the need to integrate all of these views for better understanding in system analysis.

The method developed within this research should show the understanding of different views of the system, such as: Object Oriented, Functional, Behavioral, Scenario Orientated, Implementation. The method should also show the relationship between views. The method should define how to capture the transition between design views. Special attention should be dedicated to the automatic or semiautomatic generation of alternate views and maintain their consistency across all views. Any method or techniques that will be developed should be integrated into a toolset. This toolset should be integrated into existing systems analysis development tools. A structured data base is required to support various type of captured information as well as the relationship between them. This toolset should also have the capability to integrate or interface with various analysis tools to allow the evaluation of system performance.

PHASE I: Phase I work should show feasibility. The proposed methodology should be documented in an initial methodology report. The requirement and design of the tool should be defined by the end of Phase I. Any critical risk areas of the design should have been prototyped to show feasibility of total approach.

PHASE II: Phase II work should include the full scale development of the automated tool. By the end of Phase II, a sample test case needs to be demonstrated to show the usefulness of the method and tool. The initial report should be updated to incorporate the lessons learned during the formulation of the method and the development of the tool.

COMMERCIAL POTENTIAL: Exists in the automobile and communication industries.

N93-102 TITLE: Driver for Pointer-Tracker Radar Systems

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this research is to provide and demonstrate a technique for constructing a compact high power, low emittance electron beam source

DESCRIPTION: The purpose of this research is to develop a compact, high power electron beam source. This source should have the following characteristics. The source should be capable of producing a 1 microsecond electron beam with a beam energy adjustable in the range from 1 MeV to 5 MeV with a repetition rate variable up to 1 Khz. The beam voltage flatness should be within 1 % or better for the microsecond pulse duration. The beam current deliverable should be at least 100 amperes at 1 MeV and 20 Amperes at 5 MeV. Preference will be given for higher current capability and voltage flatness less than 1 percent. In addition, it is desirable to have a minimum instantaneous axial energy spread in the beam or low beam emittance.

PHASE I: The design shall be completed with all pertinent calculations showing its viability. In addition particle in cell simulations should be performed which show the evolution of the electron beam emittance as it passes through the accelerator. In addition, a small benchtop proof of principle demonstration may be performed.

PHASE II: an actual operational device should be constructed. This may be a scaled down version of the final system, however it should incorporate all of the final systems features and successfully answer any design issues which remain before proceeding to a final full scale device.

PHASE III: Transition to a Navy program is anticipated and should be justified on the basis of radar (pointer-tracker) applications. The electron beam source is needed for innovative microwave, mm wave, IR sources.

COMMERCIAL POTENTIAL: Exists in the material processing industry.

N93-103 TITLE: Explosions of Coated Boron Particle Clouds in Air

CATEGORY: Exploratory Development

OBJECTIVE: To develop dispersion and ignition of coated boron particle clouds in air and measure blast preasures.

DESCRIPTION: Previous NAVSWC SBIR projects have developed the technology to prepare thinly coated (10 to 100 Angstroms) small boron particles (diameters less than 10 microns) with metals such as magnesium and aluminum. Of interest

is the dispersion of the coated boron particles in air to form clouds with subsequent explosion.

PHASE I: Research should focus on proving the ability to inject and form coated boron clouds in air and understand the ignition conditions and measure the explosion blast pressure.

PHASE II: Research should further develop the experimental techniques to disperse and ignite the coated boron clouds with measurement of blast pressures. Experimental conditions such as dispersion conditions, type of metal coating (Mg versus Al), particle size, coating thickness, and coated versus uncoated particles should be systematically studied and related to blast pressure.

COMMERCIAL POTENTIAL: Exists in propulsion systems

N93-104 TITLE: Electromagnetic Millimeter Wave Nondestructive Evaluation of Radomes

CATEGORY: Exploratory Development

OBJECTIVE: Develop Measurement System for the nondestructive evaluation of radomes and relate such evaluation to antenna performance.

DESCRIPTION: Glass/epoxy and ceramic radomes are used by the Navy in communication and weapon systems. Radomes affect the performance of the enclosed antenna in regard to boresight error, signal power, phase distortion, sidelobe levels, etc. Anomalies and defects sometimes exist in as-fabricated radomes, and are searched out via a variety of nondestructive evaluation techniques. Special approaches based on minimeter wave technology are sought that can quantitatively relate the anomalies so detected to the performance characteristics of the transmitting and the receiving antennas.

PHASE I: Demonstrate the principles for the design of the proposed measurement system and the analysis for the effects of defects in a radome on antenna performance. Proof of concept testing is required on specimens provided by the Navy.

PHASE II: Construction and delivery of prototype equipment, analysis and software to the Navy.

COMMERCIAL POTENTIAL: Exists in the communication, aerospace and weapon industries.

N93-105 TITLE: Equipment Specification Authoring Tool with Multimedia

CATEGORY: Exploratory Development

OBJECTIVE: Develop software to author equipment specifications.

DESCRIPTION: A rules based expert system for authoring specifications based upon MIL-STD-2036 (Navy), "General Requirements for Electronic Equipment Specifications" is required by Navy Program Managers and engineers to assist in tailoring equipment requirements in accordance with Navy policy to allow for the deployment of commercial, ruggedized and full-mil hardened equipment.

By exploiting the technologies of artificial intelligence and multimedia, one integrated software package can be developed to provide a multimedia instruction delivery system about military environments and custom tailor specifications for equipment.

The expert system will be rules based using forward or backward chaining algorithms to reduce equipment requirements. The instruction delivery system will tutor the user on commercial, ruggedized and full-mil equipment. The multimedia images will be sourced from stock Government videos of shock trials, Gulf War deployments, missile launches and environmental testing of equipment.

PHASE I: Show the feasibility of the concept.

PHASE II: Develop a complete user-friendly system for automatically producing specifications for electronic equipment according to MIL-STD. Package system on CD-ROM including all documents relating to MIL-STD-2036 for easy on-line access. Provide users manual for system.

PHASE III: If successful, the application would be of interest throughout the Department of Defense and Industry.

COMMERCIAL POTENTIAL: Exists in industries using expert system databases.

NAVAL UNDERSEA WARFARE CENTER/NEW LONDON

N93-106 TITLE: Visualization of Complex Active Sonar Information

CATEGORY: Exploratory Development

OBJECTIVE: To develop innovative techniques for presenting complex tactical sonar information, particularly that used for classification and environmental acoustics analyses, to sonar operators on displays in an easily understandable form.

DESCRIPTION: Active classification data and active sonar environmental acoustics data is multidimensional and complex. Complexity derives from the uncertain quality and the quantity of data to be presented. A wide variety of efforts in developing visualization of scientific data should be relevant to this specific problem. Software and hardware development is not sought under this topic. The techniques would be implemented on independently developed Navy systems. Display technology is no longer an issue, support for visualization techniques exists. The issue is in organization and presentation of information to a sonar operator who has particular experience and education, not to engineers and scientists.

PHASE I: Identify several visualization approaches and methods for evaluating their effectiveness. Develop static representations of approaches.

PHASE II: Would consist of development and evaluation of selected approaches using measurements of effectiveness from Phase I. Prototypes would be developed on displays, furnished by the Government, consistent with tactical system capabilities. Evaluations would be conducted with actual processed data furnished by the Government.

PHASE III: Navy funding - to support development of system requirements for implementation of selected approaches in one or more tactical systems - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

N93-107 TITLE: Composite Periscope Mast

CATEGORY: Advanced Development

OBJECTIVE: To study the feasibility of using a composite material to replace the existing periscope outer tube.

DESCRIPTION: U.S. submarine periscope outer tubes are designed and manufactured based on the mechanical constraints of stainless steel (Type 304/316 or similar). Given that the periscope is located in the upper part of the ship, the added weight of stainless steel increases the center of gravity, and further, the mechanical strength limits the upper operating speed of a submarine when the periscope is extended. Composite materials offer the possibility of a much higher strength to weight ratio and in some cases, a higher ultimate strength.

PHASE I: Study the applicability and suitability of using composite materials to replace the existing periscope outer tube. The strength of and mechanical characteristics to support the periscope inner mast structure and SUBSAFE issues shall be addressed. Properties which will enable an increase of the existing operating envelope and overall survivability during UNDEX exposure are of specific interest. Phase I will conclude with performance predictions and a trade-off study.

PHASE II: Develop and test prototype hardware. Full design disclosure and test data will be provided to enable transition to and follow-on production.

PHASE III: The possibility exists for full scale production for new periscope masts.

N93-108 TITLE: Multispinning of Directionally Solidified Terbium-Dysprosium

CATEGORY: Exploratory Development

OBJECTIVE: Develop melt spinning techniques to form directionally solidified terbium-dysprosium polycrystalline alloy.

DESCRIPTION: The design of rare earth magnetostrictive transducers utilizing terbium-dysprosium at 77 K presents several technical challenges. One is the need for a consolidated laminated stack of thin sections of the material in order to minimize eddy current losses. Fabrication of the pieces using traditional techniques involving machining pieces is very costly. There is a need for thin sections of directionally solidified terbium-dysprosium polycrystalline alloy manufactured in a cost-effective manner. The utilization of melt spinning techniques to form the Tb6 Dy4 material in a directionally aligned thin section will result in a more attractive driver material for inclusion in high power, underwater sonar transducers being exploited under the auspices of the ONT NU3B Block.

PHASE I: The effort will result in a conceptual study and complete plan for the metallurgical techniques. The contractor shall identify technical issues and problem areas expected in the process and construct a specification for the material process. A technical report shall include background and past efforts in the field, plans for Phase II, and expected performance.

PHASE II: The effort will result in the demonstration of the technique in forming thin (much less than 10 mils) strips of aligned material and a pilot run of material for evaluation of its magnetoelastic and magnetostrictive properties. The contractor shall deliver samples of the material (strips not more than one inch in width and weighing approximately 5kg) for testing and characterization at planned intervals in the development. The final delivery shall consist of 10kg of material and a complete technical report.

PHASE III: The Phase III effort will be a transition of the material fabrication technology to the Tactical Active Transducers task under the ONT N03B Submarine/Surface Ship ASW Surveillance Block. Follow on effort to be negotiated as a Task under the Naval Undersea Warfare Center, Newport Divisions Submarine/Surface Ship ASW Surveillance Technology Area Block Program, UN3B.

N93-109 TITLE: Low Storage Volume Vertical Array

CATEGORY: Exploratory Development

OBJECTIVE: Develop a low storage volume vertical array construction which, when deployed in the ocean, expands to become a low drag, faired shape.

DESCRIPTION: A vertical array anchored to the bottom and held vertical by an underwater float is a useful sonar array for many shallow water Navy applications. Deployment of these arrays is envisioned to be by submarine, airplane or UUV (unmanned underwater vehicle). These deployment methods place a premium on storage volume. They also make recovery of the array difficult if not impossible which requires that the overall array be low enough in cost to make it disposable. A 200 foot long vertical array requires only 100 pounds of float tension to hold it in its prescribed vertical position. The required cross-section of the vertical array could be less that 0.25" in diameter, and the majority of that is required for a coaxial cable to support data transmission. The overall deployed volume of the array and float can be minimized if the low drag shape is used for the vertical array as opposed to a simple cylindrical shape. This volume can be further reduced for storage if the faired shape is composed of a thin membrane which is inflated after or during deployment of the vertical array. The inflation can be achieved by a small pump, osmotic pressure from the surrounding sea water, or any other method which minimizes storage volume. The task will be to develop such a low storage volume construction while stressing low overall array assembly costs.

PHASE I: Identify low volume array construction and deployment scenarios. Develop and test prototypes. Document advantages and disadvantages of different concepts along with expected construction costs and storage volume.

PHASE II: Develop the equipment and manufacturing technology needed to make long low cost lengths. Produce 200 foot lengths; measure drag coefficient at low speeds and determine packing efficiency.

PHASE III: The Navy would recommend this construction to various Navy vertical array programs where deployment volume is at a premium and low cost is important.

N93-110 TITLE: Alternate Periscope Antenna Radome Development

CATEGORY: Advanced Development

OBJECTIVE: To develop a replacement periscope antenna radome using a composite material.

DESCRIPTION: Recent changes in the chemical composition of NORYL syntatic material has had a detrimental effect on the mechanical properties for its use in periscope applications. The Naval Undersea Warfare Center, which is the In Service Engineering Agent for submarine periscopes has been pursuing the problems associated with NORYL used in periscope radomes. While there does not appear to be any direct replacement material, some of the composites have RF and mechanical characteristics that lend themselves to radome applications.

PHASE I: Phase I of this effort is to study and compare several new composite materials which have both structural and RF properties that are suitable for radome applications (i.e., high strength, low radar cross section and low insertion loss). This study shall be based on the Type 8L(Mod T), 15L(Mod T), and 18B/D Periscope applications. Further, a conceptual design(s) will be modeled for those materials which are most suitable, and a table of performance predictions/trade-offs will be provided.

PHASE II: Phase II will fully develop and test prototype hardware. Full design disclosure and test data will be provided to enable transition to and follow-on full scale production.

PHASE III: A possibility exists for full scale production of new periscope antenna radomes and retrofit on existing models.

N93-111 TITLE: Nondestructive Inspection Techniques for Composite Material Components

CATEGORY: Engineering Development

OBJECTIVE: To develop and demonstrate nondestructive techniques for internal inspection of composite material components with complex surfaces and a thickness of at least three inches.

DESCRIPTION: The Navy anticipates increasing use of composite materials because of their lower costs and their potential material advantages including acoustic characteristics. One application area for composites is in the fabrication of components for underwater vehicles - for example propellers, launcher impellers. Required are innovative nondestructive techniques for internal inspection of such components both at initial fabrication and during the life of the component. Techniques should be capable of inspecting, in-situ, components at least three inches thick, with complex surfaces and with overlapping parts closely spaced together. The ideal techniques would also permit inspection in seawater.

PHASE I: Proposals should include discussion of: (a) the defect indicators covered by the proposed technique-for example, delamination, presence of voids, fiber direction, fiber waviness, conformation to the design drawings; (b) the resolution of the proposed technique. Develop the technique and demonstrate it sufficiently enough for the Navy to determine whether further work is warranted.

PHASE II: Design, fabricate, and test a prototype of the inspection equipment.

PHASE III: The Navy may be a limited potential customer for some commercial equipment.

N93-112 TITLE: Shallow Water Sonar Model for 10 Kilohertz through 500 Kilohertz

CATEGORY: Engineering Development

OBJECTIVE: sonar model, shallow water, predictive sonar model, active sonar, passive sonar, coastal waters

DESCRIPTION: The Navy is concentrating considerable effort to develop hardware systems and tactics to conduct ASW and ASUW in shallow water environments. To further these efforts, a requirement exists for a sonar model that can predict the acoustic environment for active and passive sonars operating at frequencies from 10 Khz to 500 Khz in water depths of 600 feet and less. In the long term, the model should be applicable to the variety of shallow water environments in which future conflicts are likely to occur and should be capable of dealing with the range of bottom types, bottom morphologies, and other critical environmental factors characteristic of such environments. For the SBIR effort, documented data should be used from representative shallow water coastal environments; other models for these environments, to the extent available, should be used as checks.

PHASE I: Demonstration of a partial model operating up to 100 Khz with a check, insofar as possible, against other models.

PHASE II: Development and demonstration of a full model for representative environments.

N93-113 TITLE: High Energy Density Propulsion Systems for Underwater Vehicles

CATEGORY: Exploratory Development

OBJECTIVE: To design and demonstrate innovative, high energy density propulsion systems for small underwater vehicles.

DESCRIPTION: The Navy uses a variety of small underwater vehicles such as torpedoes, mines, unmanned underwater vehicles (UUV's). These vehicles can differ considerably in size, but an outer hull diameter of 21 inches maximum is generally not exceeded. The need is for innovative, high energy density propulsion systems for such vehicles. Issues of concern include: cost; environmental compatibility; human physical safety; shelf life. Design issues to be addressed include: type of power;

recharge or regeneration time (if proposed power source is reusable); type of propulsor; run time in terms of vehicle size, speed, and depth; size and mass of propulsion system relative to vehicle size; vehicle applicability range. Since a range of proposed approaches is possible, proposals must show sufficient evidence of understanding of problems to be addressed, of system feasibility, and of contractor's ability (experience and knowledge) to carry out proposed work for the Navy to make an informed Phase I award decision.
Proposals can be provided for entirely new innovative systems or for innovative improvements to present systems which will result in significant performance improvements.

PHASE I: Perform system study and analysis. Provide sufficient design decision support to allow the Navy to determine whether additional effort is warranted.

PHASE II: Perform more detailed design and demonstrate key technologies.

PHASE III: Navy funding - for successfully demonstrated key technologies - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

N93-114 TITLE: Active Vibration Isolation

CATEGORY: Exploratory Development

OBJECTIVE: To develop techniques to actively cancel machinery generated, low frequency vibrations.

DESCRIPTION: Methods of actively canceling low frequency vibration are required to reduce hull transmitted noise from machinery mounted inside torpedo hulls. Current passive mounts are ineffective in attenuating this low frequency energy. Cancellation techniques must be able to identify and cancel a number of discrete frequencies. The active cancellation system must integrate with existing passive mounts and physically fit within the limited space available. Cancellation techniques should be able to address dynamic forces in the 1 - 10 lb range, be as compact as possible and be integrated with a miniaturized control/feedback system.

PHASE I: Project should demonstrate a technique's ability to identify, follow, and cancel a minimum of the 3 highest amplitude peaks in the vibration spectrum of a mounted machinery item between 0 and 1500 Hz.

PHASE II: Expected results from a Phase II project would be a prototype system which would be installed in an actual torpedo and be tested under normal operating conditions.

PHASE III: Navy funding - for a production item in Phase III - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

NAVAL AIR WARFARE CENTER/WARMINISTER (NAVAL AIR DEVELOPMENT CENTER)

N93-115 TITLE: Satellite Imagery Transmission Technology Development

CATEGORY: Advanced Development

OBJECTIVE: To develop an efficient means of satellite imagery transmission

DESCRIPTION: Currently, the Navy has developed near real-time reconnaissance systems which transmit imagery acquired from high resolution cameras to remotely located command centers via satellite communications link. However, due to the limited data transmission bandwidth (2 to 25 KH_z) available from secured satellite channels, the need exists to develop a means of efficient imagery transmission without sacrificing resolution in areas of interest within the imagery. Thus, innovative methods are sought for representing (compressing) and processing reconnaissance imagery prior to transmission via satellite and for reconstructing the imagery at the receiving station. Issues such as compression, segmentation, feature extraction, error correction and modelling must be addressed.

PHASE I: Will develop performance requirements and provide analysis on best-case, worse case and mean probably performance levels of candidate techniques, and will develop a high fidelity work station conceptual design and a program performance specification.

PHASE II: Implementation and delivery will be accomplished in Phase II.

PHASE III: Transition to surveillance platforms such as the P3, S3 and existing laptop imaging transmission equipment

NAVAL AIR WARFARE CENTER/TRENTON (NAVAL AIR PROPULSION CENTER)

N93-116 TITLE: Development of a Barkhausen Noise Technique for Aeronautical Bearings and Gears

CATEGORY: Engineering Development

OBJECTIVE: Develop a Barkhausen noise technique that can be utilized for detecting and preventing detrimental residual tensile stresses in mechanical components.

DESCRIPTION: In the manufacturing of rolling element bearings and gears, finish grinding processes can cause local changes in material properties which impart residual tensile stress into the near surface region of the part. These stresses are detrimental to component life and should be avoided. Unfortunately, current industry-wide NDI techniques are inadequate to detect subsurface tensile stress. The Barkhausen noise method has demonstrated an ability to characterize subsurface stresses up to a depth of 0.0005 inches, but further development is required before this method can be fully utilized.

PHASE I: Consists of evaluating the capabilities/limitations of this method using currently available equipment, and identification of areas in need of further development, including alternate measuring techniques.

PHASE II: Entails further development of the method and application to current materials and design used in aeronautical bearings and gears for possible incorporation into a military specification.

N93-117 TITLE: Helicopter/Tilt-Rotor Gear Box Debris Monitoring System

CATEGORY: Engineering Development

OBJECTIVE: To develop and efficient and reliable system for monitoring gear box wear debris, providing advanced warning of impending failure, and capturing the debris for analysis.

DESCRIPTION: Current chip detectors in use in aircraft do not provide adequate early warning of impending failures. When indication occurs, it is not known how quickly the debris was generated, or what size the particles(s) were. Current systems have three drawbacks, they are prone to false indications, they do not provide adequate warning because they do not trend the debris generation and they do not adequately collect the debris for analysis. The goal of this effort is to develop a debris monitoring system that eliminates false indications, improves the wear particle capture efficiency, and develops associated algorithms for accurate failure identification.

PHASE I: Conduct the design review of all available technologies for debris monitoring, and demonstrate the enabling technologies meeting the design requirements. If no such technology exists conduct a study with recommendations for a design that will meet the requirements.

PHASE II: Use Phase I results to integrate and evaluate the monitoring system in an aircraft gear box. Evaluation may be during aircraft ground testing or gear box rig testing.

PHASE III: A Navy Phase III effort is anticipated.

NAVAL COMMAND, CONTROL & OCEAN SURVEILLANCE CENTER/RDT&E DIVISION (NAVAL OCEAN SYSTEMS CENTER)

N93-118 TITLE: Thermally Conductive Coatings for Aluminum Hardware

CATEGORY: Advanced Development

OBJECTIVE: To develop a thermally conductive coating for the protection of aluminum hardware from the effects of corrosion and abrasion in the marine environment.

DESCRIPTION: The Navy requires a protective coating for aluminum alloys which provides protection from corrosion in the marine environment and abrasion due to frequent handling. "Hard anodize" (MIL SPEC MIL-A-8625C, Type III) has been used for years for this purpose, but has been found to be too thermally insulating to be used for high-efficiency steam condensers which are used in marine propulsion. Recent tests at Nrad have shown that certain plated metal coatings have potential for providing the necessary protection as well as good thermal conductivity. Electroless Nickel coatings carefully applied on 6061-T6

aluminum (4 mil thick) showed minimal corrosion after 1000 hours in a B117 salt spray chamber. The desired operational performance desired is several years lifetime in a marine environment without significant corrosion and without scratches due to handling.

PHASE I: Produce a metal coating with the potential of withstanding the equivalent of 2000 hours in 5% neutral salt spray with no significant corrosion failure and no penetrating scratches due to handling. In this effort evaluate the following aspects of the coating procedure:

(1) Pretreatment of the aluminum hardware.
(2) Use of undercoats to reduce porosity or galvanic corrosion due to pinholes.
(3) Electrolytic versus electroless plating.
(4) Multilayered coating strategies.
(5) Post-treatments, sealants.
(6) Tests for the prediction of the coating performance.

PHASE II: Optimize the potential coating(s) developed in phase I and apply to a SCEPS condenser.

PHASE III: Navy funding - to transition the technology into the MK 50 torpedo production and other advanced torpedo and underwater vehicle systems - is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

N93-119 TITLE: Multi-Octave Passive VHF/UHF Antenna Technology

CATEGORY: Exploratory Development

OBJECTIVE: To develop a small, lightweight, broad-beamwidth, multioctave antenna which has a useable gain greater than 0 dBi and which can operate without degradation of these characteristic parameters in the presence of a 3.3 Watt per meter squared power density.

DESCRIPTION: There is an existing need within the Navy to remotely monitor shipboard radio frequency (RF) emissions over the specified frequency spectrum. As a result, affordable, broadband electromagnetic field probes which may be packaged into small, lightweight systems are being sought. For frequencies above 500 Mhz, small multioctave antennas are already available. Below 500 Mhz, the antennas become excessively large with less relative frequency coverage. The present task addresses this problem and requires the entire 30 - 500 Mhz frequency range.

PHASE I: Should include design, fabrication, and demonstration of a proto-type antenna.

PHASE II: Should involve the further development, packaging, and performance improvement required for system insertion of the candidate antenna.

PHASE III: To be negotiated as a Task under Surface Ship Technology Area Block Program, SCIB.

N93-120 TITLE: Integrated Broad Band Receiver-Transmitter Technology

CATEGORY: Exploratory Development

OBJECTIVE: To solicit new concepts and approaches in integrated broad band receiver-transmitter technology which satisfy current deficiencies in size, weight, signal distortion, phase coherency, rapid scanning, programmability, adaptability, and receiver processing of sophisticated signal formats.

DESCRIPTION: Rapid Advancement of Ultra Broad Band Radar technology has created a very apparent need to refine the architecture and organization of surveillance/targeting and provide a fully integrated ultra broad band receiver-transmitter system to detect, classify, and identify a wide range of covert radar emitters. The fully integrated system must also be capable of (1) detecting extremely small radar cross section targets such as sea skimming and cruise missiles, (2) providing high resolution range measurements of the order of a few centimeters which can discriminate between objects such as real missile warheads and decoys, (3) providing improved capabilities for penetrating foliage, earth, or walls which is of particular interest for detecting relocatable targets, and (4) reducing sensitivity to electronic countermeasures. The methods of search, acquisition, and tracking must be addressed with plans for maximizing the throughput of useable data, while achieving rapid acquisition. A system of autonomous operation for the accurate direction finding/location, classification, and identification of radio emitters as applied to drone aircraft and missiles requires improved solutions.

PHASE I: Will address approaches to increasing the signal bandwidth of a radar system, will identify the most suitable

approach, and will perform sufficient analysis and design to indicate a reasonable probability of success in Phase II for feasibility demonstration.

PHASE II: Will use the approach defined in Phase I to develop and deliver hardware/software to the Government for test and evaluation.

N93-121 TITLE: Tunable Narrow Band Optical Filters for the Blue-Green Spectral Region

CATEGORY: Exploratory Development

OBJECTIVE: To develop tunable narrow optical filter in the blue-green spectral region between 450 and 550 nm.

DESCRIPTION: The Navy has sponsored the development of optical filters for various communications systems over the last two decades. Generally these filters have had very narrow optical narrow bandwidths, but only operate at fixed wavelengths. The Navy currently has application for narrow band (on the order of 1 angstrom) filters that are tunable over the entire blue-green spectral region. The filters must be capable of tuning to any arbitrary wavelength in the spectral range in less than 1 second. Filters proposed under this topic need not have large apertures (apertures down to one square centimeter are acceptable), but the technology should lend itself to scaling to larger apertures (perhaps as large as 1 square meter).

PHASE I: Should address the design and critical technical issues associated with the production of these new filters.

PHASE II: Should provide a high quality prototype filter with a maximum bandpass of a one Angstrom, that is tunable over a spectral range from 450 to 550 nanometers.

PHASE III: Follow-on effort to be negotiated as a Task under the Naval Command, Control and Ocean Surveillance Center, RDT&E Division Laser Technology Area Block Program, CS2C.

NAVAL SURFACE WARFARE CENTER/CARDEROCK (DAVID TAYLOR RESEARCH CENTER)

N93-122 TITLE: Malone Cycle Compressor and Expander

CATEGORY: Exploratory Development

OBJECTIVE: Develop Malone Cycle Cooling for Potential Shipboard Use

DESCRIPTION: The Navy has a requirement to replace CFC refrigerants in shipboard air conditioning and refrigeration machinery. The Navy solicits proposals that address development of compressors and expanders for use in Malone Cycle cooling.

PHASE I: Demonstrate compressor and expander that will operate using Malone Cycle (liquid) fluids with a critical temperature of approximately 70 to 200 degrees F.

PHASE II: Develop prototype Malone Cycle Cooler system that uses sea water at 88 degrees F as the heat rejection reservoir. Size, weight, power consumption, reliability, and safety are critical parameters.

PHASE III: If Phase II is successful, full scale development will be considered for future ship systems (PE63721N or PE63513N).

N93-123 TITLE: Active Control Systems For Ship Silencing

CATEGORY: Exploratory Development

OBJECTIVE: Develop active controllers for more effective ship silencing.

DESCRIPTION: Devices currently used for ship silencing have been designed by passive means such as isolation and damping treatments. To further reduce the noise on the shipboard and noise generated through interaction with water, active means for controlling the ship noises in various aspects should be considered. Current interest particularly lies in mounting active devices on the ship hull to isolate the shipboard noise from being transmitted to the water or preventing the reflection of the incoming acoustic signals from the echo-ranging projector. Active control systems for such applications are needed. This topic solicits proposals for innovative concepts to advance the technologies involved, with emphasis on the following areas: Design Analysis

Tools. This effort is to develop new generation integrated design, analysis and simulation software tools in a computationally efficient environment for predictive evaluation of the silencing performance by different control system designs. Active Control Systems. Innovative controllers consisting of system architectures, actuators, sensors, algorithms, etc. for affordable effective ship silencing.

PHASE I: A complete survey of the state-of-the-art design analysis tools for active controller design and its structural-acoustic performance. A specific approach to develop and integrate these tools and how this integrated approach can be used to identify a practical control system for this specific application. Status report of the development effort and delivery of the developed software.

PHASE II: Delivery and demonstration of the integrated software package with full documentation. Laboratory demonstration/verification of the performance of the identified active control system on a small scale finite cylinder model being on the surface of and under the water subject to internal excitation and external acoustic signal incidence.

PHASE III: Navy funding is contingent and may be provided depending upon the proposals received, the Naval priorities assigned the Phase III efforts, and the quality of the results produced.

NAVAL CIVIL ENGINEERING LABORATORY

N93-124 TITLE: Fuel Oil and AFFF Removal

CATEGORY: Exploratory Development

OBJECTIVE: Develop a combined treatment system to separate and remove residual fuel oil and AFFF from firefighting training waste.

DESCRIPTION: Treatment and disposal of fuel and AFFF-laden wastewater generated from firefighting training facilities and shipboard equipment testing has been a major Navy operational problem. A cost effective removal technique for these contaminants must be developed for the Navy application. A combined gravitational and air flotational separation method can cost effectively be employed to treat such waste.

PHASE I: Determine the separation characteristics and requirements. Other methods may also be practical for a treatment system. Conduct lab evaluation experiment to integrate the system configuration.

PHASE II: Design and fabricate prototype system for lab and field testing. Conduct the test and evaluation of the prototype system. Develop the design specs for the field application system.

PHASE III: Phase III effort is anticipated to take advantage of the results of this effort.

N93-125 TITLE: Non-distributing Asbestos Detection System

CATEGORY: Exploratory Development

OBJECTIVE: Identify and evaluate mechanisms and components to detect and measure asbestos fibers in an environment.

DESCRIPTION: Measurement of asbestos fibers in an indoor environment has been a time consuming, inaccurate, and expensive process. A non-disturbing (of the air), rapid, accurate and inexpensive detection system will be developed using combined laser beam and mass spectrometry technologies.

PHASE I: Investigate the detection mechanism/requirements. Evaluate laser beam and mass spectrometry components capabilities and functionalities. Establish integrated principles and configuration of the components.

PHASE II: Design and fabricate the asbestos detection system. Test and evaluate the system and generate design criteria for a pilot type system. Develop a field test protocol.

PHASE III: Phase III effort is anticipated to take advantage of the results of this effort.

N93-126 TITLE: Decontamination of Pentachlorophenol (PCP)-Treated Wood

CATEGORY: Exploratory Development

OBJECTIVE: To identify and evaluate suitable technology for the decontamination of wood contaminated with

pentachlorophenol.

DESCRIPTION: Six million pounds of wood were treated with the wood preservative pentachlorophenol (PCP). PCP concentration in the wood is approximately 1,000 ppm. High concentrations of heavy metals Cr, As, and Cu have also been found in the wood. The installation recently got a "Notice of Violation" from the State (CA) for failure to maintain the site. In addition, the installation has been monitoring air vapors and soil in the vicinity of the wood, and apparently there's no air nor soil contamination. NAVWPNSTA Seal Beach has also tried to leach some of the PCP out of the wood but have been unsuccessful. Incineration is not a viable option since the metals may present air pollution control problems. Bio-remediation has also been ruled out as the high concentration of heavy metals will render the microorganisms ineffective.

PHASE I: Identify techniques for determining physical and chemical characteristics of the wood in order to assess a suitable technology to be implemented for remediation. A detailed report will be produced including wood characterization data, factors limiting a specific remediation approach, and recommendations for ultimate disposal.

PHASE II: Evaluate the technology of choice proposed in Phase I in an on site pilot scale evaluation.

N93-127 TITLE: Determination of Factors Affecting Complete Mineralization of Ordnance Compounds (TNT)

CATEGORY: Exploratory Development

OBJECTIVE: To determine factors that allow mineralization of TNT to innocuous end products.

DESCRIPTION: Numerous studies have revealed that TNT has been found to be bio-transformed but not mineralized by a diverse group of microorganisms in a numbers of environments. These microbes generally catalyze nitro group reduction but are not known to cleave aromatic ring structures. The resistance of the ring structure to degradation results in a number of metabolites binding to organic materials and in the formation of toxic by-products.

PHASE I: Perform a survey of existing data and identify the factors that contribute to degradation. Analyze results of previously performed experimentation in the degradation of TNT. Develop a computer relational database that will incorporate factors affecting degradation of TNT and predict degradation rates under similar environment scenarios. A report containing results, computer models and recommendations will be delivered.

PHASE II: Laboratory Scale Evaluation. Degradation factors identified in Phase I will be assessed in a series of laboratory experimentation procedures. A set of contaminant standards as well as representative samples will be subjected to identified degradation factors by the computer model. The progress of a control group not subjected to the identified biodegradation factors will also be monitored.

N93-128 TITLE: Soil Slurry Bio-reactor for Ordnance Compounds

CATEGORY: Exploratory Development

OBJECTIVE: To develop a soil slurry bio-reactor system for bio-remediation of soils contaminated with TNT and RDX.

DESCRIPTION: Results from a bench-scale study using soil from an Army Ammunition Plant (Joliet Army Ammunition Plant) demonstrated that it is feasible to biologically treat soil and groundwater contaminated with ordnance compounds TNT and RDX. In the Army study, a silicone tubing, fixed-film reactor was tested with two different microbial populations, white rot fungus Phanerochaete chrysosporium and a bacterial based consortium. In the reactor containing the white rot fungus, TNT was removed from the liquid solution under nonligninolytic and ligninolytic conditions. The development of a "soil-slurry bio-reactor" for ultimate treatment of soil contaminated with ordnance compounds is required.

PHASE I: Perform a survey of existing data and identify and analyze results from previously performed efforts. Contacts with the Army and Argonne National Laboratory will be established in order to obtain information already generated from the Army's study.

PHASE II: System Design. Based on the data generated by previously performed experimentation, a soil slurry bio-reactor system suitable for remediation of soil contaminated with ordnance compounds will be developed.

PHASE III: Phase III effort is anticipated to take advantage of the results of this effort.

N93-129 TITLE: Lead Hyperaccumulators

CATEGORY: Exploratory Development

OBJECTIVE: To identify and evaluate lead hyperaccumulators for adaptation to hazardous waste site cleanup.

DESCRIPTION: Lead is an ubiquitous environmental contaminant of our air, soil, and water. Studies have shown that lead is uptaken by vegetation growing in heavily contaminated soils. Algae have also been identified to remove heavy metals from aqueous solutions.

PHASE I: Identify potential candidates from vegetative, fungal, and bacterial sources that have the potential to uptake lead from the environment. A field survey will then be conducted from known lead contaminated sites, DOD and non-DOD. Preliminary pot studies will be conducted of potential species to determine uptake capabilities.

PHASE II: Laboratory Evaluation: After several candidate species have been identified, detailed laboratory investigation will ensue to determine mechanism of uptake and concentration factors. This will entail water and soil media. A detailed report of findings will be prepared with recommendation for field testing.

N93-130 TITLE: Subsurface Landfill Barrier

CATEGORY: Exploratory Development

OBJECTIVE: To identify, develop and evaluate methods and materials for implementation as subsurface barriers between hazardous waste landfills and an aqueous environment.

DESCRIPTION: Navy landfills were often constructed in coastal areas that have resulted in severe infiltration of water, both from groundwater and tidal fluxes. This influx of water carries potential harmful constituents into the environment. This creates a difficult situation to remediate. Containing the contaminants within the landfill confines will assist in final remediation.

PHASE I: Identify methods and materials for barriers that can be installed at abandoned hazardous waste landfills. Potential methods and materials will be subjected to tests for effectiveness, both cost and functional. Take into consideration factors such as intrusion of animals, tree roots, etc.

PHASE II: Field demo. After laboratory investigation, a detailed field test will be conducted at an actual site or one that simulates actual conditions that may be encountered.

PHASE III: Phase III effort is anticipated to take advantage of the results of this effort.

N93-131 TITLE: Rapid High Rate Lead in Air Monitor

CATEGORY: Exploratory Development

OBJECTIVE: To develop and evaluate rapid air monitor for lead monitoring at rifle ranges.

DESCRIPTION: Lead, along with other metals, is a concern to users of both indoor and outdoor small arms firing ranges. It is dispersed through the air, soil, and water. Studies have shown that lead is found in significant quantities in air samples from indoor ranges. Air samples need to be taken quickly so not to interfere with the shooters concentration and results must be obtained in the field for safety reasons.

PHASE I: Identify potential methods of monitoring lead from rifle range field exercises. Calibrate and demonstrate monitoring techniques and technology.

PHASE II: Field demo. After laboratory investigation, a detailed field test will be conducted at an active range to determine viability under range of conditions that may be encountered.

PHASE III: Phase III effort is anticipated to take advantage of the results of this effort.

N93-132 TITLE: NDT Technique(s) for Detecting Delaminations in High Temperature Pavements

CATEGORY: Exploratory Development

OBJECTIVE: Investigate fundamental nondestructive testing (NDT) principles, select the most applicable principle, and develop

an innovative detection system based on that principle.

DESCRIPTION: Current pavements become delaminated after repeated exposure to aircraft jet exhaust. The delaminations normally occur at a depth of about 1/4 to 1/2 inch but depths of about 1/8 to 3/4 inch have been observed. The areal extent of the delaminations could range from several inches to many feet in diameter. Indications of the delaminations are usually not visible on the pavement surface. Existing NDT techniques, such as impact echo, chain drag, and infrared tomography, are deficient, not applicable, or inappropriate to satisfy requirements for the required system. A new system that has the following capabilities is needed:

a. For a specific x,y location on an airfield pavement, detect whether or not delamination exists.

b. For each location where delamination was detected, provide a measurement of the depth to the plane of the delamination from the surface.

PHASE I: Make an assessment of applicable fundamental NDT principles, perform a tradeoff analysis of candidate principles based on a selection criteria, select the best principle(s), and develop and demonstrate a laboratory model of the desired detection system. Prepare a final report that documents all Phase I efforts and design criteria for a prototype system for field application.

PHASE II: Develop, test, and evaluate an NDT system(s), which has the capabilities described above and the principle(s) of which was demonstrated in Phase I, for use in conducting field surveys of airfield pavements. Prepare a final report to document all Phase II efforts including field validation test results.

PHASE III: Phase III effort is anticipated to take advantage of the results of this effort.

AIR FORCE

PROPOSAL PREPARATION INSTRUCTIONS

The responsibility for the implementation and management of the Air Force SBIR Program is with the Air Force Materiel Command Deputy Chief of Staff for Science & Technology. The Air Force SBIR Program Manager is R. Jill Dickman. Do NOT submit SBIR proposals to the AF SBIR Program Manager under any circumstances. Inquiries of a general nature or problems that require the attention of the Air Force SBIR Program Manager should be directed to her at this address:

Department of The Air Force
HQ AFMC/STIP (AF SBIR Program Manager)
Wright-Patterson AFB OH 45433-5001

No additional technical information (this includes specifications, recommended approaches and the like) can or will be made available by Air Force personnel during the solicitation period. The only source for technical information is the Defense Technical Information Center (DTIC). Please refer to section 7.1 in this solicitation for further information on DTIC.

For each Phase I proposal, send one original (with red appendices A and B) and three (3) copies to the office designated below. Also, send an additional set of red appendices A and B, which are not stapled or mutilated in any way. Be advised that any overnight delivery may not reach the appropriate desk within one day.

TOPIC NO	ACTIVITY/MAILING ADDRESS (Name and number for mailing proposals and for administrative questions)	CONTRACTING AUTHORITY (For contractual questions only)
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AF93-007 thru AF93-014	HQ AFCESA/RAXM (SBIR Program Manager) 139 Barnes Drive Tyndall AFB FL 32403-5319 (Msgt Jim Davis, 904-283-6299)	Maureen Preta (904) 882-4141
AF93-015 thru AF93-022	AFOSR/NI (SBIR Program Manager)* Bldg 410, Rm 219 Bolling AFB DC 20332-6448 (Dr. Dale Boland, 202-767-5013) * Hand delivery can be accepted after calling ahead to (202) 767-5013	Harry Haraldsen (202) 767-4993
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AF93-061 thru AF93-089	PL/XPP (SBIR Program Manager) Bldg 592, Rm 24 Kirtland AFB NM 87117-6008 (Robert Hancock, 505-846-4418)	Roger Shinnick (505) 846-4457
AF93-090 thru AF93-096	PL-OLAC/TSTR (SBIR Program Manager) Bldg 8353, Rm 116 Edwards AFB CA 93523-5000 (Chris Degnan, 805-275-5014)	Roger Shinnick (505) 846-4457
AF93-097 thru AF93-102	PL/XPG (SBIR Program Manager) Bldg 1107, Rm 240 Hanscom AFB MA 01731-5000 (Noreen Dimond, 617-377-3606)	John Flaherty (617) 377-2529
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AF93-001 TITLE: Characterization of Simulated Weather Environments In Aerospace Ground Test Cells

CATEGORY: Exploratory Development

OBJECTIVE: Develop a system to continuously define the velocity, concentration, size and distribution of weather simulate.

DESCRIPTION: A critical concern within the aerospace community is the ability of antennas and visual windows to continue transmit or receive information in all environments. As illustrated in the desert storm conflict, the defence of and delivery of ordinance is limited if weather or dust diminishes the effectiveness of the antenna windows. In order to evaluate the effectiveness of erosion and structural fracture resistance and the performance of the windows material, a system that characterize the test medium being used for the weather or battlefield dust simulation is required. The system needs to continuously determine the spatial distribution, size, velocity and direction of travel of the particles in the test flow field just prior the impact on the test specimen. The instrument should meet simulated flight environment from sea level up to 200,000 feet, speeds from 0 to hypersonic Mach numbers, and particulates size of 0.1 to 1 millimeter at concentrations from a few part per million up to opaque concentrations of typical sandstorms and typical sand grain sizes. Silica dioxide, graphite, ice and others are used to simulate impacts in wind tunnel and arc test. Weather simulates currently used consist of plastic balls, water droplets and ice crystals again of various size and concentration. Phase I should demonstrate the feasibility and phase II should result in demonstration of a prototype system in a wind tunnel at AEDC.

AF93-002 TITLE: Non-Intrusive Water Droplet Size and Mass Flux Measurement

CATEGORY: Exploratory Development

OBJECTIVE: Develop a non-intrusive water droplet size and mass flux measurement capability to support on-line engine/inlet icing testing.

DESCRIPTION: A non-intrusive system to make single point as well as spatial uniformity measurements of water droplet size of three to one hundred microns and mass flux ranges of 1.5 x E-4 to 47.0 x E-4 lbm water per lbm of air is required. The system must function in an engine test cells with ducting diameters varying from approximately three to twelve feet and in a flow field in which the water droplets will be entrained at approximately 0.2 to 0.5 Mach and provide real time or near-real time output. Current system are limited to measurement made in approximately one foot diameter duct. The system must be compatible with foreign object damage fears associated with engine tests. The accuracy of the measurement system should be plus or minus 3 microns in diameter and plus or minus ten percent of water mass flux. The system should not affect the freezing characteristic of the droplet or contaminate the water. It should be capable of scanning the entire test ducting to obtain spatial distribution of droplet size and mass flux in real time or within 10 minutes at the minimum. Phase I should demonstrate the concept and phase II will result in demonstration of a prototype system in a test cell at AEDC.

AF93-003 TITLE: Infrared Viewer for Turbine Engine Internal Surfaces

CATEGORY: Advanced Development

OBJECTIVE: Develop an infrared viewer for mapping the radiation emitted by the internal surfaces of turbine engines.

DESCRIPTION: The interpretation of infrared imagery data for inclusion in aircraft propulsion signature prediction computer codes requires the measurement, at near normal viewing angles, of the radiation emitted from the internal surfaces of the engine exhaust nozzles undergoing test at simulated altitudes. The Infrared Viewer should be capable of mapping the radiation emitted from the entire internal surface of the tailpipe with a spatial resolution of +- 2.0 cm. The viewing angle should be near normal to the surface (plus or minus 20 degrees). The viewer should be capable of making measurements in the 2.5 to 14.0 micron band. The viewer should have a signal to noise ratio of at least 10 and an absolute accuracy of +- 10% while measuring radiation in the 2.5 to 14.0 micron band from a 70.0 degree C black body surface. The viewer should be capable of operating in a tailpipe with an inside diameter from 30 to 100 cm with a total length of up to 180 cm. The diameter of the viewer at the engine nozzle exhaust plane shall be no greater than 5.0 cm. The viewer should be capable of operating in an exhaust gas stream with a total pressure of 3.0 atmospheres and a total temperature of 975. degrees C. The viewer should be capable of scanning and recording the data for the entire engine tailpipe in 60 seconds or less. During Phase I the initial concept will be

formulated, initial feasibility calculations performed, and optical breadboard of the system set up and an adequate signal to noise ratio demonstrated. During Phase II a detailed design for a prototype viewer will be prepared and a prototype suitable for installation in a turbojet engine altitude test cell will be built, checked out at the contractors facility, and delivered to AEDC.

AF93-004 TITLE: Storage Heater Material Optimization

CATEGORY: Exploratory Development

OBJECTIVE: Determine the composition of yttria stabilized zirconia which minimizes life cycle cost.

DESCRIPTION: Regenerative storage heaters possess the potential to provide high temperature, high mass flow, particle-free, and chemically correct air to hypersonic wind tunnels. Temperatures on the order of 4600 degrees Rankine are believed achievable using known materials and heat transfer design methods. One parameter which significantly impacts heater life-cycle costs is the percent yttria required to stabilize zirconia. Other known parameters are: thermal stress effects, material erosion, and the standby temperature (minimum allowable temperature of the material between runs) of the heater. Engineering development of an optimum material which minimizes total life cycle cost (factoring in capital costs, material maintenance costs, standby temperature maintenance costs, and operational costs) is critical to the feasablitity of the concept. In Phase I, an analysis will be performed to arrive at a proposed optimally designed material for use in a facility similar to the "Tripletee" facility described in the reference, except the bed dimensions will be 7 feet in diameter and 21 feet in length. Factors in facility design which will effect the optimum material design will be identified. In Phase II, samples of the proposed optimum material will be constructed and tested in order to validate the analysis performed in Phase I.

AF93-005 TITLE: High-Speed Flow Visualization

CATEGORY: Exploratory Development

OBJECTIVE: Visualization system for flow structure about aerodynamic shapes in transient, hypersonic flow.

DESCRIPTION: A flow visualization system is required to provide imaging of real gas flow structure (shock standoff distance, shock position, boundary layer) about aerodynamic shapes in transient, hypersonic ground test facilities at Arnold Engineering Development Center. Present visualization systems can obtain only one image during a tunnel run, and this is inadequate for defining the temporal characteristics of the flow over an aerodynamic shape. Typical freestream conditions for an air flow are 1400 K static temperature and 4E+17 molecules per cubic centimeter static density for a Mach number of approximately 7.4. An imaging rate of at least 80 KHz is required in order to obtain at least 80 images during the nominal 1 millisecond run time. In order to provide discrimination against flow and model radiation, the system will have to contain a high speed, short duration illumination system. Nine inch diameter Suprasil ports are available for viewing and illuminating the flow, and the entire system can be mounted to and isolated from the shock tunnel. Phase I should focus on conceptual development, parametric studies, and feasibility calculations. Phase II should result in a prototype system to be tested in a transient, hypervelocity facility at AEDC.

AF93-006 TITLE: Hypervelocity Projectile Balloting Model

CATEGORY: Advanced Development

OBJECTIVE: Develop a mathematical model to predict balloting of models in hypervelocity ranges such as the AEDC G-Range.

DESCRIPTION: A prediction code to accurately determine the balloting (lateral bouncing) of models in hypervelocity ranges needs to be developed. The code should be able to integrate the effects of imperfect launch tube straightness, dynamic gas forces, projectile wear, and interactions of all causes. There has been research into this field by the U.S. Army, however the effects of gas dynamics on balloting were not considered. The Phase I effort should include an evaluation of the state of the art in code development, determination of the theoretical basis for the code, and conceptual design of an appropriate computational model to address hypervelocity range projectile balloting. Phase II should be development of the actual computational tools, to include hardware and software, resulting in a system which is able to predict balloting in hypervelocity

ranges. A validation comparison of computational predictions ver . tual data from AEDC G-Range tests should be accomplished at the completion of the Phase II effort.

AF93-007 TITLE: Defense Non-aqueous Phase Aquifer Remediation

CATEGORY: Basic Research

OBJECTIVE: Develop a chemical/physical treatment process to remediate aquifers contaminated with dense nonaqueous phase liquids (DNAPLSS) in situ

DESCRIPTION: Hazardous waste sites contaminated with DNAPLS (usually chlorinated solvents) present special problems to remediation activities. The dense organics sink to the bottom of the aquifer to form pools or disassociated droplets (ganglia) of pure phase product. This pure phase then slowly leaches into the surrounding aquifer, providing a long term source of contamination.

Phase I: Is the development and proof of concept of a treatment system to remediate a 10 cubic foot test cell contaminated with trichloroethylene. It will also provide scale up and operating parameters for a phase ii effort. Restoration verification of the test cell will include soil analysis down to the parts per million level and water analysis down to the parts per billion level.

Phase II: If approved, will be the operation of the treatment system at a contaminated air force selected site. Bioremediation and "pump-and treat" technologies are outside the scope of this topic.

AF93-008 TITLE: Biological Methods for Complete Destruction of Nitro-substituted Contaminants

CATEGORY: Basic Research

OBJECTIVE: Develop innovative biological methods for the destruction or biodegradation of nitro-substituted compounds in contaminated soil or waste streams.

DESCRIPTION: Knowledge surrounding the biodegradation of nitrogenous contaminants such as energetics, missile fuels, and nitroaromatic solvents and explosives is limited. Early research led to the conclusion that nitro compounds either resist biodegradation or are reduced to amines which are more toxic than the parent compounds. Recent research conducted at the air force civil engineering laboratory has suggested that novel oxidation reactions can completely detoxify nitrogenous contaminants. These discoveries suggest that biological treatment will be effective for degrading nitrogenous compounds. Current technologies include composting and incineration. The composting process produces unknown, potentially toxic, intermediates and incineration is an extremely expensive treatment option. There is an ongoing need to understand the biochemical mechanisms and to develop new biological processes for complete destruction of these compounds.

Phase I: Should identify novel processes for the complete biodegradation of nitro-substituted contaminants including nitrobenzenes, nitrotoluenes, rdx, hmx, and tent that could lead to the development of a biotreatment system for contaminated soil or waste streams.

Phase II: Effort would be expected to implement the development and testing of such a system using contaminated material.

AF93-009 TITLE: Improved Formulation of Fire Fighting Agents for Hydrocarbon Fuel Fires

CATEGORY: Basic Research

OBJECTIVE: Develop an environment benign AFFF firefighting replacement

DESCRIPTION: The current generation of aqueous film forming foams (AFFF) is not totally biodegradable. Life span of the agent when loosened into the environment is estimated to be over 25 years. AFFF is used extensively by dod firefighters in flightline operations to extinguish fires due to hydrocarbon fuels. AFFF is a superb extinguishing agent; however, there are problems associated with its effectiveness for extinguishing rolling fuel fires and its efficiency for securing the fire after its initial extinguishment. Additionally, there is a problem with the biodegradation of AFFF that has an ecological impact under current environmental legislation practices. It is desirable to develop an improved fire suppression agent for flightline firefightering that

is also environmentally acceptable. The environmental performance characteristics of candidate surfacts chosen for the ability to spread across hydrocarbon fuels and suppress flame propagation under static and dynamic conditions will be established.

Phase I: Will establish the parameters for developing a fire suppression agent with the capability of extinguishing rolling fires in flight operations.

Phase II: Will develop a surfactant formulation that enhances the fire fighting capabilities of the present technology and invents a formulation which has less impact on the environment. This formulation must not have fluorosurfactants which contribute to environmental presistancy; however, the formulation must not sacrifice AF's superior fire knockdown capability.

AF93-010 TITLE: Environmental Benign Anti-Icing Agents for Airfield Use

CATEGORY: Basic Research

OBJECTIVE: Develop biological anti-icing agents meeting air force standards, are cost effective, and have negligible environmental impact

DESCRIPTION: The ability to maintain ice-free aircraft and runways affects the safety and readiness of the air force flying mission. Maintaining compliance with environmental regulations also affects air force operations. All chemicals discharged to the environment have some level of impact. The major impacts of the current deicers are toxicity to aquatic organisms, the oxygen demand they impose in surface waters as they degrade, contamination of groundwater used for drinking water supply, and in the case of nitrogen containing deicers such as urea, the eutrophication of surface waters by their nutrient loading. When many deicers such as glycols are degraded by microorganisms, oxygen is usually consumed; stated differently, a biochemical oxygen demand (bod) is exerted. In general, most deicing chemicals such as glycols and urea rapidly biodegrade in the environment exerting a high bod. The result is the depletion of oxygen in the aquatic environment and mortality of organism such as fish and invertebrates. An even more serious problem with urea is that it degrades to ammonia which is highly toxic to fish. Low temperatures and dilution from heavy runoff (snowmelt) during periods of use tend to minimize the immediate and future impact on surface waters. However, the potential for exerting bod remains until warm temperatures return and microorganism metabolism increases. In cold environments, the potential of surface runoff containing these chemicals to enter the groundwater is also high since they will not be degraded. Once the chemical is in the groundwater very little degradation will occur and the primary mechanism reducing the toxicity is dilution. Due to these problems many regulatory authorities are requiring airports to control these wastewaters for subsequent treatment or disposal. Runway deicing chemicals containing ethylene glycol and urea are being phased out of use in the air force due to the environmental impacts. In the environment there are organisms and plants that can withstand freezing by preventing critical fluids from forming ice crystals. This is analogous to anti-icing. Microorganisms that inhibit ice nucleation have been used to prevent frost from forming on fruit crops. These biological mechanisms that prevent the nucleation process that initiates the formation of an ice crystal(or the derived biological agents) may have application to runway anti-icing.

Phase I: Will provide proof-of-concept of developed anti-icer having similar ice preventing performance as urea and ethylene glycol without the environmental impact.

Phase II: Will provide a full-scale field demonstration of anti-icer, validate performance and ability to meet air force regulation 91-15, and obtain approval by air force materials laboratory, Wright-Patterson AFB, Oh.

AF93-011 TITLE: Environmental Engineering Research

CATEGORY: Basic Research

OBJECTIVE: To develop new innovative ideas/concepts in the area of environmental engineering

DESCRIPTION: Environmental engineering research includes environmental behavior and fate of air force fuels and chemicals; hazardous waste minimization; treatment and pollution control; environmental chemistry; advanced pollutant monitoring technology; biodegradation of pollutants; and concepts to eliminate, substantially reduce, mitigate environmental consequences of future air force weapons systems

AF93-012 TITLE: Deployable Refrigerant Recycle and Recovery Unit

CATEGORY: Basic Research

OBJECTIVE: Develop a refrigerant recycle and recovery unit for use with bare base environmental control units

DESCRIPTION: A field deployable refrigerant recycle and recovery unit is needed to minimize environmental damage as a result of releasing CFC refrigerants into the atmosphere during maintenance and repair of these units. The deployable unit will be compact and ruggedized to operate under a variety of adverse wartime conditions and should be capable of handling a variety of CFC and HFCF refrigerants. This effort will support both existing c100 environmental control units and a mobile heat pump currently under development.

Phase I: Deliverable will be a concept of operation to include details on suggested equipment design and construction, expected performance and durability, total expected weight, and assembly time

Phase II: A prototype will be constructed and tested for performance.

AF93-013 TITLE: Bare Base Planning

CATEGORY: Basic Research

OBJECTIVE: Produce software to aid engineers in bare base facility planning

DESCRIPTION: United States Air Force have typically conducted warfighting operations from a network of main and satellite operating base. However, US participation in regional conflicts outside the sphere of influence of existing us bases requires the rapid buildup of a warfighting airbase, typically called a 'Bare Base'. This program will require the development of personal computer based software to assist in the engineering layout of these bases. The design and layout of the Bare Base requires the assimilation and analysis of data from several sources of guidance. Without full consideration of this guidance, bare base planning may become time consuming and inconsistent. A user-friendly computer based methodology that will facilitate optimal bare base planning is needed. This program must include a listing of all facility and utility categories, the requirements that must be considered for layout of each facility and other concerns threat, terrain, weather, etc. That should be addressed in utility/facility layout. After addressing the layout requirements, estimates of facility size must be developed, general lists of what is necessary to build these facilities, and construction scheduling.

Phase I: Product does not have to include a graphical representation of the proposed layout.

Phase II: A detailed planning toolwill be required, which may include the ability to show a graphic representation of the base. This would include a deployment schedule of engineering materials for base construction, detailed facility size requirements and alternative siting plans.

AF93-014 TITLE: Water Containerization/Distribution System for Arctic Use

CATEGORY: Basic Research

OBJECTIVE: Develop a potable water containerization and distribution system for bare base installations in arctic environments

DESCRIPTION: Current potable water containerization and distribution systems are not designed for operation in extremely cold temperatures. These existing systems require intensive maintenance to ensure continued operation. A lightweight, mobile potable water storage and distribution system is required to provide continuous supply for up to 300 personnel (200 gal/day) in temperatures as low as -70 degree fahrenheit. Set up time for the system must be less than six hours.

Phase I: Deliverable will be a concept of operation to include details on suggested equipment types, materials of construction, and total expected weight and assembly time.

Phase II: Furnish cold weather operational and maintenance data on the suggested equipment and materials based on laboratory environmental operational testing, optimum equipment and material specifications and mobility packaging and assembly plans.

AF93-015 TITLE: Structural Integrity of Intelligent Materials and Structures

CATEGORY: Basic Research

OBJECTIVE: Characterize the interactions between sensors, actuators, and host materials in intelligent material systems.

DESCRIPTION: Considerable effort within the Department of Defense research community has been recently focused on the development of intelligent materials and structures. These materials and structures have the ability to adapt to their environments through shape and/or material property modification. Applications of this technology include vibration and instability suppression, shape modification, and noise suppression. However, the complex microscale interactions between the sensors, actuators, and the host materials must be characterized before this technology can reach its full potential. Of particular importance is the understanding of the inherent geometric, material, and time-dependent nonlinearities within the intelligent material systems. Long-term usage of intelligent materials and structures may produce internal damage within the sensor/actuator. The fatigue life of these material systems needs to be further investigated. The understanding developed at the microscale will then be coupled with macroscale models to determine the optimum number of sensors/actuators that are necessary for a given application and the appropriate placements of these devices for optimal control. This project will address the mechanics that govern the complex interactions between sensors, actuators, and their inherent nonlinearities, providing a fundamental understanding that is needed for further development.

Phase I: Phase I will initiate the development of mathematical models for intelligent material systems.

Phase II: Phase II will further develop and verify these models through appropriate testing.

AF93-016 TITLE: Organic/Polymeric Nonlinear Optical Materials

CATEGORY: Basic Research

OBJECTIVE: To conduct research on developing organic/polymeric Nonlinear optically active material systems suitable for fabricating thin films or fibers for photonic applications.

DESCRIPTION: Research proposals are sought for developing organic/polymeric based material systems suitable for thin film or fiber processing. The material system must be nonlinear optically active (either second order or third order). In addition to possessing the necessary second or third order nonlinearity for device applications, the material system should be optimized for all necessary secondary properties suitable for device fabrication and utilization. These properties may include thermal stability, temporal stability, solubility, melting characteristics, low optical loss and compatibility with other materials needed in devices. The relationship between the target properties and the target device should be clearly delineated in the proposal. The chemistry approach to achieve the target properties should be clearly stated. All photonic devices/applications will be acceptable as research targets but special emphasis will be placed on optical beam steering, high frequency (hundreds gigahertz) phase modulation, and harmonic generation. The proposed research will be evaluated with emphasis on the innovativeness in studying the integration of existing knowledge of structure-properties relationships over the development of such relationships.

Phase I: Phase I results should establish the feasibility of the chemistry and the properties of the proposed material system.

Phase II: Phase II effort should be developing the material to a degree of maturity suitable for utilization in device research.

AF93-017 TITLE: Self Designing Flight Control Systems

CATEGORY: Basic Research

OBJECTIVE: The development of a flexible implementation framework and methodology for a real-time, on-line, self designing flight control system.

DESCRIPTION: Aircraft flight control systems require compromises in peak performance, design difficulty, and implementation of resources. Present flight control design practices result in unduly restricted operational capabilities, a lack of flexibility, and an overall system whose performance is not sufficiently robust to unusual events such as failures and damage. The desire for peak performance under all conditions usually introduces gain scheduling to transition between controllers. This gain scheduling is often complex and is rigid, and must be redesigned for each new circumstance. A continuous, real-time, on-line, self

designing approach could yield the benefit of continuous optimal control. The optimization could be extended to the outer loop, such as guidance and trajectory control, so that inner and outer loops can be optimized together. This is crucial in applications such as hypersonic aircraft and missiles where the inner and outer loop cannot be separated. The self designing controller is applicable to a broad array of military as well as civilian applications, including robotics and autonomous vehicles. Advances in onboard computing power, sensor technology, adaptive materials, and nonlinear adaptive control theory have put the possibility of intelligent, high performance, self designing flight control systems within reach. The research goal is to understand how these advances can be integrated in a practical way to develop a self designing control system which continuously optimizes performance and which can accommodate events such as failures, anomalies, and damage, as well as maximize the aircraft flight envelope, maneuverability, and changing mission requirements. This will greatly enhance the aircraft lethality, survivability, configuration, and mission completion probability.

Phase I: Assess the feasibility, practicality, and the current technology limitations of the concept of a self designing controller. Develop a flexible, conceptual design framework, and the critical analytical and computational tools needed for a proof of concept for an onboard, real-time, on-line, self designing flight control system.

Phase II: Develop the design methodology for implementing a high level conceptual prototype of a self designing controller on derivative aircraft, and provide proof of concept on simulations. The structure of the designer should be demonstrated with the component modules in place and exchanging information for some streamlined, realistic scenarios.

AF93-018 TITLE: Wide Bandgap Semiconductors for High Temperature Electronics

CATEGORY: Basic Research

OBJECTIVE: Develop new compound semiconductor materials suitable for the fabrication of high temperature electronics devices.

DESCRIPTION: Electronic devices and circuits capable of operation at temperatures in excess of current MIL SPEC limits (> 200 degrees C) offer significant advantages for atmospheric and space electronic systems. These advantages include the reduction of space, weight and power required for environmental cooling systems and increased reliability. The current focus is on Group IV-based (SiC, diamond) materials. The wide bandgap compound semiconductor materials, particularly III-V nitrides, offer alternative approaches. This program seeks innovative approaches to grow, characterize and use these and related materials. Specific attention must be devoted to high temperature electronic applications.

Phase I: The feasibility must be demonstrated for a particular material or device preparation.

Phase II: It is expected that the Phase II will carry the concept to the point of a characterization device.

AF93-019 TITLE: Quantum Well and Superlattice IR Detector Development

CATEGORY: Basic Research

OBJECTIVE: Develop quantum wells and superlattices of Group III-V, IV, and II-VI semiconductors for use in infrared detectors sensitive to wavelengths beyond 12 micrometers.

DESCRIPTION: Innovative concepts and demonstrations are sought for the development of quantum well and superlattice infrared detectors for wavelengths beyond 12 micrometers. Surveillance in the infrared part of the electromagnetic spectrum supplies crucial information to see objects which could otherwise escape detection. This program will develop IR detectors sensitive to wavelengths beyond 12 micrometers which will supply tracking information on objects in space and at very high altitudes. Semiconductor materials and structures will be developed and optimized to perform at the highest temperatures consistent with maximum sensitivity for the assigned mission. Concepts using near normal incidence radiation are desired. The approach is to use designed materials to break the constraints that presently prevent access to important regions of the IR spectrum with affordable and reliable systems.

Phase I: Emphasizes novel detection concepts and may include research on the control of epitaxial growth processes, theoretical design of quantum well (QW) and superlattice (SL) structures, growth of the structures with appropriate layer thickness and doping, complete evaluation of the structures' optical, electrical, and magneto-optical properties, and design and processing of IR detectors and arrays.

Phase II: Will further develop the successful device concept, to include material characterization and device fabrication. Proof of principle will be demonstrated.

principle will be demonstrated.

AF93-020 TITLE: Rare Earth Doped Semiconductor Devices and Structures

CATEGORY: Basic Research

OBJECTIVE: Explore electronic and electro-optic device concepts and structures of technologically important semiconductors doped with rare earth impurities.

DESCRIPTION: The interest in rare earth or lanthnide-doped Group IV and II-V semiconductors has led to investigations involving luminescence, life-time, and electrical measurements, doping through numerous techniques (e.g., implantation, MOCVD, MBE), the fabrication of light emitting diodes, doping experiments in quantum well devices, and growth of semimetallic rare earth/Group V compounds on semiconductors. The interest continues in producing DC-pumped rare earth-doped solid state lasers, opto-electronic applications for silica and non-silica based fiber optics, impact devices, and the possible use of rare earth-doped devices for frequency standards. In recent years erbium-doped silica fibers have been successfully applied to amplify optical signals for transmission over long distances; applications which integrate the fibers with active elements on III-V and Group IV semiconductors are being considered. Other possible applications are rare earth ion laser materials, optically pumped by heterojunction emission in the host material. The key to many of the studies has been the proper incorporation of the rare earth ion into the semiconductor host and exciting the internal 4f-4f luminescence transition not only optically, but also electrically. There is a need to develop the capability to grow thick and high concentration rare-earth doped semiconductor layers so that fundamental experiments and device developments can be performed. For optoelectronic integration, the growth technique necessitates good control of heterostructures and epitaxial layers and an overall thick total layer combination.

Phase I: Research shall identify device concepts and device structures which will lead to relevant electronic and electro-optic applications. This phase will also allow for the further development of productive growth techniques for doping, with rare earths, technologically important Group III-V and Group IV semiconductors. Appropriate material characterization of the doped layers may be part of this phase.

Phase II: This would develop the fabrication procedures and demonstrate the proposed device structures.

AF93-021 TITLE: Persistent Spectral Hole Burning Materials for Optical Memory and Processing

CATEGORY: Basic Research

OBJECTIVE: Grow rare earth or transition metal-doped host materials for persistent spectral hole burning applications.

DESCRIPTION: Many modern computer and processor architectures are limited in performance by insufficient degrees of freedom. Optical and opto-electronic approaches can ameliorate the resulting bottlenecks by providing spatial parallelism and high temporal bandwidth. Employing optics' spectral breadth provides an alternative access to its temporal capacity; device researchers have exploited the spectral domain to implement both processing and memory. This extra dimension can be embodied in a material that supports spectral hole burning. That is, in a material whose absorption spectrum is in homogeneously broadened. Every known material that demonstrates spectral hole burning is inadequate in some of the various characteristics important for either memory or processing. Depending on application, features that can be important include: persistence time of spectral holes (in excess of 10 minutes is required for many memory applications; extremely low temperatures may be required); ratio of inhomogeneous to homogeneous linewidth (greater than 10,000 is desirable); optical absorption cross-section, and practicable dopant density of active species (near or exceeding 1%); and correspondence of the absorption wavelength band with the emission wavelength of a diode laser source (generally, between 700 and 1600nm). In addition, some mechanism for gating the simulation or relaxation of the atomic transition can enhance efficiency and prolong persistence. Current materials generally require extremely low temperatures to retain their persistent spectral hole burning character; although cryo-coolers to provide this environment reliability and efficiently are under development, materials that function at a temperature nearer to 77K than 5K are desirable. The materials of interest in providing these attributes comprise various host materials doped with rare earth elements or, conceivably, with transition metals. Opportunity exists for developing the capability to grow and supply these rare earth and transition metal doped hosts, many of which may require very high process temperatures. Various oxides such as yttrium aluminum oxide and yttrium silicate may be considered among candidates for active species host. Other prospects include semiconductor materials, diamond or other carbon structure, yttrium oxide, calcium

tungsten oxide, and various halide salts. Indicated dopant densities of rare earth or transition metal active species exceeding 1% should be realized to warrant extended investigation.

Phase I: The objective is to identify, rationalize, and evaluate candidate persistent hole burning materials (very low temperature operating environment is allowable). Identification of the growth procedure capable of producing the material in reasonable specimen sizes and quantities, at reasonable cost, is expected (thin films on substrates may be considered). Prototype growth to demonstrate actual capability will provide a stronger basis for continued support into Phase II.

Phase II: The objective is to optimize growth procedures for selected materials, ensure reproducibility, and demonstrate controlled incorporation of dopants into the host material. Material selection will be made in consultation with the program manager. Material specimens will be made available for applications oriented characterization to the program manager and his designates in the Air Force Laboratories and supported by AFOSR programs.

AF93-022 TITLE: HTS SQUID Magnetometry for NDI of Aircraft

CATEGORY: Basic Research

OBJECTIVE: Design, build and test an HTS SQUID magnetometry system to detect subsurface defects in aircraft.

DESCRIPTION: Air Force logistics operations have several major priorities relating to the detection of subsurface structural defects in the metallic skin of its aging aircraft. At the present time there is no existing technology to detect such defects reliability in flight-line operations. Present commercial eddy-current techniques have insufficient sensitivity to give unambiguous information on the structural integrity of aircraft at depths of about one inch below the surface. Yet, small cracks and corrosion are often present in older planes at such depths, especially near rivets and similar fasteners. Recent research with helium temperature (LTS) SQUID magnetometry in a laboratory environment has indicated that the increased sensitivity of this instrumentation (down to very low frequencies) enables it to detect even very small cracks at depth. While it would be difficult to adapt an LTS system to a flight-line environment, it should be possible now to develop a compact, portable HTS SQUID system which can be oriented in any direction. It is only recently that HTS SQUIDs and coupling coils operating in the range of liquid nitrogen temperature could be manufactured reliably with sufficiently high sensitivity. At the same time a new generation of reliable, efficient, small-scale cryocoolers has emerged for operation down to 65 degrees K. By combining a cryocooler (or small liquid nitrogen dewar that can be used in any orientation) with HTS SQUIDs and other HTS elements, it should be possible to build a small, self-contained unit for routine aircraft maintenance operations and with a sensitivity to detect small cracks at a depth of about one inch in aluminum structures.

Phase I: Phase I will include the design of the complete system based upon information obtained from Air Force logistics personnel and aircraft manufacturers, and upon investigation of HTS SQUIDs, HTS coil configurations and cryogenic systems.

Phase II: Phase II the complete system will be constructed, assembled and tested on standard defect structures, as well as on Air Force equipment.

AF93-023 TITLE: Human Systems/Subsystems Research

CATEGORY: Basic Research

OBJECTIVE: Develop innovative human-related systems or subsystems for aerospace applications.

DESCRIPTION: Proposers may submit ideas to enhance man's capability to function effectively and safely as an integral part of Air Force systems and military operations while increasing mission success. This includes the following: 1) human factors engineering, such as methods improving human/machine and human/computer interfaces or enhancing human physical or cognitive performance; 2) personnel protection/life support, such as crew escape in high Mach environments; 3) chemical/biological warfare defense, such as advanced personal protection and detection, identification and warning systems; 4) occupational/environmental hazards, such as identification of and protection from toxic materials and electromagnetic radiation; 5) personnel training and simulation, such as new computer-based technologies that improve the effectiveness and reduce cost of training systems; 6) aeromedical support, such as medical risk assessment and medical data collection, analysis and management; and 7) logistics support, such as logistics design and maintenance aids. Ideas are solicited that affect any or all of the operations, maintenance, and support roles of Air Force personnel.

AF93-024 TITLE: Improvements in High-Altitude Life Support Equipment and Diagnostic Technology

CATEGORY: Exploratory Development

OBJECTIVE: Develop low resistance breathing system components; advanced decompression/denitrogenation computer systems; and ebullism protection garmentry.

DESCRIPTION: Specific areas include the following: (Specify subtopic by letter)

a. Flow resistance offered by current USAF aircraft oxygen systems limits the rate at which breathing gas is delivered to the crewmember. High breathing resistance adds work stress, discomfort and distraction to an already high workload, stressful, flight environment. High inspiratory resistance may produce reduced G-tolerance by reducing the effectiveness of anti-G respiratory straining maneuvers. It may also contribute to the episodes of hypoxia and abnormal respiratory gas exchange. Identification of the flow resistance contributed by each of the component parts of currently deployed oxygen systems will enable us to identify the components which are the best candidates for redesign. Current systems fall short of meeting the standards set down by the Air Standardization Coordinating Committee for aircrew breathing systems. Suggested design changes and prototype low resistance components are needed to advance future development of these systems toward meeting these standards. Phase I efforts will identify the flow resistance in each of the components and suggest design changes for the components which are significant contributors to breathing resistance. Phase II will produce a brassboard low-resistance breathing system, from the regulator to the oronasal mask, for standard aircrew operations.

b. Develop advanced decompression/denitrogenation computer systems for real time and predictive decompression sickness risk assessment. High-altitude exposures in aircraft, hypobaric chambers, and with extravehicular activity (EVA) in space result in an inherent risk of decompression sickness (DCS). In the past, general guidelines for safer altitude exposures have been developed through costly time-consuming studies, each specific to unique altitude exposure scenarios. The results of these studies are often difficult to apply to new altitude requirements. Therefore, new, time-consuming studies must be undertaken. Rapidly changing technology in aircraft design dictates improved decompression risk assessment capability. Data bases exist for the development of a standardized altitude decompression/denitrogenation model, such as exists on altitude decompression computers. These computers are needed for both real- time DCS risk information as well as DCS risk predictive capabilities. Utilization of such hardware is anticipated in aircraft cockpits, or hypobaric chamber control stations, in EVA suits, as high altitude mission planning computers. Phase I will develop the software program for the decompression model, and Phase II will provide a hardware prototype for further operational development.

c. Operations in both advanced, high-altitude aircraft and in space have the potential for accidental human exposure to hypobaric environments in which the ambient pressure is less than the vapor pressure of water. Under such conditions the water in human tissues may vaporize, causing considerable expansion of the affected tissues. Body containment garments, in combination with positive pressure breathing systems, have been suggested as one possible means of protecting aircrew in these environments. Such a garment would be p73 designed to passively restrict the swelling of enclosed tissues in the event of accidental depressurization. The envisioned garment, which would be incorporated into the aircrew clothing ensemble, should be lightweight, comfortable, and allow adequate freedom of movement. Phase I efforts will identify and evaluate existing and emerging garment materials and conduct proof of concept demonstrations with the most promising materials. During Phase II a variety of prototype garments will be designed, fabricated and tested to produce a design specification suitable for full-scale development efforts.

AF93-025 TITLE: Behavioral Chronopharmacological Technology

CATEGORY: Exploratory Development

OBJECTIVE: Develop a lightweight, durable means to record chronophysiological activity and control active transdermal drug infusion.

DESCRIPTION: Specific areas include the following: (Specify subtopic by letter)

a. Many stressful events encountered by military personnel are manifested in the body by physiological events. For example, cortisol is released to generalized stress; melatonin levels may indicate the extent of circadian dysrhythmia; and glucose measures suggest rate of energy and oxygen utilization. Since time and techniques are usually limited in field assays, measures are sought which will rapidly provide a reasonably close approximation of more sophisticated measures. Although test kits are available for many of these assays, they involve sampling from blood. Since blood assays are invasive and require extensive preparation and handling, they are unacceptable. Phase I will involve a monitoring system that uses saliva or perhaps urine or

sweat to register more than one physiological parameter. Phase II will adapt the size and durability of the system for operational use. Such a device must allow operational military personnel to quickly determine and document their level of physiological stress (fatigue or otherwise). The device would have civilian applications in that it would allow patients to better administer their medications with greater awareness of their current physiological state.

b. Numerous life-threatening events exist for military personnel that could be attenuated with accurate chemical intervention. For example, the biological damage produced by nerve agents can be reduced by precisely timed pre-treatment drugs. Similarly, incapacitating fatigue can be alleviated with stimulants. Timing the bioavailability of these medications to the threat is crucial to their effectiveness. A distinct advantage of a user-controlled active patch infusion system is that is would allow the user to speed up, to slow down or to terminate drug administration if the threat no longer or never existed; these options are not available with oral administration. For example, a fatigued pilot may find it necessary to ingest a stimulant to complete the mission. Rather than experiencing the side effects associated with the brief, peak plasma concentrations after an oral stimulant bolus, a square wave-like steady state could be achieved more rapidly by a patch infusion system. Phase I will involve an infusion device that uses electrophoretic or chemical means to actively promote the transdermal administration of a wide variety of defensive drugs. It is distinguished from the passive diffusion systems found on most patch devices which oftentimes requires excessively large patches because of the slow absorption of some molecules. Phase II will involve a system designed for operational use that would be smaller, more durable and would allow for the timed administration of preventive medication closer to the onset of a threat and the termination of the infusion at any time. Civilian applications would also exist since it would allow patients better control over the steady-state kinetics of their medications. For example, older people with difficulty in remembering to take their medications would benefit because the slow, steady drug levels or the timing of multiple drugs could be automatically administered by a small microchip-driven system.

AF93-026 TITLE: Crew Protection Systems

CATEGORY: Exploratory Development

OBJECTIVE: Enhance crew protection systems in Air Force operational environments.

DESCRIPTION: Specific areas include the following: (Specify subtopic by letter)

a. A requirement exists for effective voice communications, crew safety, and human performance in environments that are based on natural, intuitive interfaces using innovative abilities and requiring no learning or training for efficient operation. The intuitive interfaces facilitate operator task performance, reduce workload and fatigue, and improve personal safety. These intuitive interface technologies include but are not limited to: 1) auditory system modeling and neural network for robust signal processing of speech; 2) digital audio technology to allow integration into aircraft systems; 3) voice communications countermeasures/ counter-counter measures; 4) noise-induced hearing loss sound protection; 5) active noise reduction; and 6) 3-Dimensional auditory display for spatial awareness and communications. Phase I efforts would provide an assessment of the state-of-the-art and an approach to develop an appropriate intuitive interface technology. Phase II efforts would provide a demonstration and validation of the intuitive interface technology.

b. Provide concepts for human control of robots in hazardous environments that combine the cognitive abilities of the human with the robustness and physical capabilities of robots. Feedback or human operator awareness of the robotics work environment expands the mission capabilities. Challenges are to develop quality force feedback from the robot to operator via exoskeleton and fine manipulation of human-sized robotics hands. Phase I effort should explore test methods and criteria for operator - robot interfaces and sensory feedback specifications or investigate novel feedback mechanisms. Phase II products should be small force feedback exoskeleton that incorporate small volume, high efficiency controlled actuator mechanisms.

c. A requirement exists for an analytical method to quantify the aerodynamic and inertial forces acting on a crewmember during emergency escape from ejection seat equipped aircraft. Efforts to improve open ejection seat performance by minimizing windblast injuries have led to various seat-mounted design concepts. Wind tunnel testing has been our primary technique for evaluating these systems, but this method can be expensive and time-consuming. Computations Fluid Dynamics (CFD) has typically been used to study the forces acting on a streamlined, aerodynamic body. Application to a bluff body ejection seat/crewmember combination has not been explored. By using CFD to evaluate different windblast protection concepts, we could essentially conduct trade studies on several windblast protection systems prior to conducting an extensive wind tunnel test program. Phase I will produce an assessment of the current state-of-the art in CFD development to determine the best approach to develop the codes necessary to predict the aerodynamic loading and aerothermal heating of an ejection seat/crewmember combination. At a minimum, CFD must allow us to predict the aerodynamic loading on the crewmember's arms, legs, and head/neck and develop an overall surface aerothermal loading profile for the crewmember. If CFD cannot currently be applied to the emergency ejection (non-rigid, bluff body) scenario, the contractor must identify and outline the CFD development efforts

necessary to use CFD as a computational aid for escape system h83 development. Phase II will identify the development efforts and methodology necessary to demonstrate and validate this computer simulation capability. It will conclude by demonstrating and validating this simulation technique.

AF93-027 TITLE: Augmented Crew Perception for Precision Strike

CATEGORY: Exploratory Development

OBJECTIVE: Develop designs for imagery delivery and integrating automated imagery interpretation into AF weapon systems.

DESCRIPTION: Develop technology to enhance the human perception process with a) alternative and enhanced helmet-mounted display technology and b) design strategies for integrating automatic target cueing/recognition with crew perception and situation awareness. (Specify subtopic by letter)

a. Develop an alternative to cathode ray tube technology which will overcome current limitations in the image-forming element of helmet-mounted displays. Size, weight, power, brightness, contrast, and resolution are all critical issues. Phase I will result in a notional design based on a well- referenced review of existing literature and on realistic estimates of candidate display technology potential. Phase II will develop a specific design and, if possible, develop a working prototype (not necessarily in scale) of the design.

b. Develop innovative strategies to the man-machine interface between aircrew members and sensor systems which contain automatic target cuer/recognizers. These strategies should be based on state-of-the-art cognitive science and be consistent with the evolving capabilities of image processing technology. The notional design delivered for Phase I should not interfere with other aircrew duties (i.e., flying the aircraft) and should provide the lowest possible error rates (misses and false alarms). Phase II should test this interface in simulation to determine whether it performs adequately and, based on the simulation results, suggest further enhancements and refinements.

AF93-028 TITLE: Passive Optometer for Night Vision Devices and Helmet- Mounted Displays

CATEGORY: Exploratory Development

OBJECTIVE: Design, develop, and test a light-weight non-obtrusive optometer.

DESCRIPTION: This requirement is for needed data on accommodation effects of imaging displays currently being researched at this division. Develop a simple, light-weight, non-obtrusive optometer that will measure accommodative responses in a continuous passive manner. Upon completion of optometer development and test activities, the system will be used by Laboratory scientists to measure accommodation responses of individuals under a variety of test conditions in conjunction with the use of night vision goggles, fiber optic helmet-mounted displays, and real image displays. The measures obtained from the optometer shall be used to gain insight into size/distance judgment biases associated with the use of these displays. Additional judgment experimentation is planned in which the optometer will be used in a stand-alone fashion to gain further understanding of the criticality of accommodation shifts in producing accurate judgments of target size and distance. Phase I will result in a design proposal for a simple, light-weight non-obtrusive optometer that could be used to measure accommodation responses in a continuous passive manner from operators using helmet-mounted devices. These devices include night vision goggles, fiber optic helmet-mounted displays, and real image displays. Phase II will result in the development, test and evaluation of the optometer proposed in Phase I. Development of this device will be of interest to DoD and to other organizations such as NASA and FAA.

AF93-029 TITLE: Gaming, Speech Processing, and Simulations for Intelligent Training Systems

CATEGORY: Exploratory Development

OBJECTIVE: Develop functional prototypes which demonstrate gaming strategies, speech processing, and simulation authoring for intelligent training.

DESCRIPTION: Gaming strategies, speech processing, and interactive simulations are emerging new technologies which can

greatly enhance the effectiveness of instructional computing systems. The following requirements reflect Armstrong Laboratory's commitment to optimizing the use of these technologies in intelligent training systems applications. (Specify subtopic by letter)

a. The successful application of artificial intelligence in the instructional arena has produced automated instructional systems with the capability to generate literally hundreds of hours of instruction. For many kinds of complex skills, performance continues to improve over very long learning curves. However, it is difficult for trainees to maintain motivation and focus in the long run, especially since performance improvement per time increment goes down significantly after initial learning occurs. One approach to generating and maintaining motivation is to introduce fun and competitive games into the training regime. These games might involve competition against a computerized opponent, against other humans, or against oneself. Phase I proposals for this topic should build a prototype Intelligent Tutoring System in a domain of mutual interest to the respondent and the Air Force, where the intelligent tutoring system uses a gaming approach to providing practice. Phase II projects would expand this prototype to a full-scale instructional system. Appropriate domains for consideration might include, but are not limited to, air traffic control, electronic troubleshooting, mathematics, and orbital mechanics.

b. Develop a flexible and efficient speech processing capability for use in conversational tutoring systems. Level of interactivity is a critical aspect of intelligent training systems. Speech recognition and generation is a new technology that can greatly improve interactivity in computer-based instruction by making student-system interactions more natural and conversational. The primary purpose is to enhance student interactivity in computer-based learning environments. Phase I will result in a set of specifications and an initial prototype which can be trained to recognize 100 words by an arbitrary speaker in less that ten minutes. Phase II will produce a fully operational speaker- independent prototype for speech recognition and processing in training applications. The Phase II prototype should be trainable to a vocabulary of 500 words in five minutes.

c. Develop a cost-effective simulation authoring capability to augment efforts to develop an intelligent instructional design advisor which can be used by subject matter experts who have had little formal training in instructional technology. Phase I will result in a concept paper with a set of specifications and an initial prototype which allows a computer-literate subject matter expert to create an object-oriented qualitative simulation in a technical training domain of mutual interest. The Phase I prototype will contain a library of a least 100 objects. Phase II will produce a fully implemented prototype which can run in an 80386/80486/80586 environment. The Phase II prototype will incorporate a library of 500 objects and provide on-line assistance.

AF93-030 TITLE: Computer-Based Assessment of Pilot Aptitude and Personality

CATEGORY: Exploratory Development

OBJECTIVE: Develop a computer-administered test battery that predicts pilot performance in combat scenarios.

DESCRIPTION: This requirement is for a computer-administered test battery that measures aptitudes and personality traits related to effective performance as a combat pilot. The Armstrong Laboratory has developed and is now implementing the Basic Attributes Test, which will be used to select Air Force pilots. Classification, i.e., aircraft assignment, will be based on individual preference, performance in undergraduate pilot training, and aircraft availability. We want to explore the possibility of a new test battery that could be used in the classification process. In particular, there is a need to identify and measure the aptitude and personality traits that predict which pilots will develop the highest levels of combat skills. (Specify subtopic by letter)

a. This requirement is for the aptitude component of the test battery to focus on the perceptual motor abilities, attentional capacity and processes, information coordination, processing speed, decision making under stress, spatial orientation, situational awareness and other performance abilities that a pilot must use in fighter and attack aircraft. Phase I of this effort will result in a set of recommendations concerning the content, i.e., psychological constructs to be measured, and design of a new human performance abilities test battery. The test battery design should build on and extend (not duplicate) the Basic Attributes Test. Phase I will also demonstrate the feasibility of the proposed test battery in the form on one executable performance test that measures one of the proposed psychological constructs. Phase II of this effort will result in a computerized test battery that has undergone initial administration, reliability analysis, and factor analysis. Proposals should assume that the battery will be hosted on a 486/33 microcomputer. Additional equipment to be used as input devices, e.g., joysticks and rudder pedals, may be proposed if necessary for the measurement of a particular psychological construct.

b. This requirement is for a computer administered battery that uses state-of-the-art developments in computer technology and psychological theory to measure personality traits associated with effective performance as a combat pilot. Past efforts to include personality measures on screening batteries such as the Basic Attributes Test have consisted of traditional self-report personality inventory items and indirect assessments through performance of a task designed to elicit particular types of behavior, such as risk-taking or decisiveness. To date, the results of these efforts have not fully utilized the potential of

computer-administration such as stratified adaptive testing, opportunities for response verification, presentation of dynamic stimuli, and recognition of patterns of personality characteristics using neural network analysis. Computer-administration has several advantages, because of computational speed and also because of the use of sophisticated algorithms and artificial intelligence. Using fairly simple algorithms, for example, the computer can check for random responding and evidence of response set while the subject is taking the test. Items can then be readministered as necessary. At a more sophisticated level, the computer can iteratively develop a model of the subject's personality, that can be refined and elaborated through presentation of appropriate stimuli in a dynamic, flexible format. In a sense, the advent of p73 computer-based personality measurement combines the advantages of an in-depth interview by a subject matter expert with the scientific rigor of a structured inventory. Phase I of this effort will result in specifications for candidate measures. Phase I will also produce sample items of inventory measures and sample demonstration forms of proposed performance-based tasks. Phase II will result in a battery of personality tests suitable for administration on a 486/33 microcomputer.

AF93-031 TITLE: Environmental Technology - Compliance

CATEGORY: Exploratory Development

OBJECTIVE: Develop sampling/analysis techniques to improve environmental and occupational health programs.

DESCRIPTION: Specific areas include the following: (Specify subtopic by letter)

a. Air Force bases are required by OSHA to monitor work areas for asbestos fibers. The present method requires that filters used to collect air samples be cut into a small wedge and prepared for fiber counting. The fiber count is manually done by phase contrast microscopy as directed by NIOSH 7400 method. The wedge must be moved at random 100 times and fibers counted in an 0.0785 mm calibrated area. The method is labor intensive and requires much time. Armstrong Laboratory requires an automated method to count asbestos fibers as per NIOSH method 7400. It is proposed that this be accomplished with a video analyzer and high resolution video camera. Image analysis could be done by computer to differentiate between asbestos and nonasbestos fibers. A multi- slide stage could be used for unattended counting. Phase I will be to investigate the possibility of this approach. Phase II will be to assemble and test such equipment to perform the automated analysis. This procedure will be of interest to other federal agencies such as the EPA.

b. Current methodologies of environmental analyses for organic species, such as pesticides and herbicides, generate large volumes of hazardous waste solvents which have characteristics that make them hazardous, cause storage and disposal problems, and cause potential exposure risks to analysts. Current approved technologies include extracting environmental samples with large amounts of organic solvents and concentrating the extracts into a small volume. Phase I will demonstrate viable alternate analysis techniques for pesticides and herbicides that drastically reduce the amount of waste solvents generated. Such techniques may employ some sort of solid phase extraction. Phase II will develop the best of those demonstrated methodologies and provide recommendations to appropriate federal agencies for approval of such methodologies as acceptable methods.

c. Current techniques for identification of organic components in hazardous waste solutions are very time consuming. Analysis time of these complex samples becomes a problem when there are many samples to be analyzed. Bases can only legally store these wastes for a short period of time and need quick chemical analyses to characterize the waste before disposal. Phase I will show the development of such instrumentation is possible, and demonstrate such quick and sensitive analyses. Phase II will develop such instrumentation, and implement the methodology so that the usable system will handle standard check solution as well as actual base-waste samples.

AF93-032 TITLE: High Power Radiofrequency Energy to Separate Types of Radioactive Waste

CATEGORY: Exploratory Development

OBJECTIVE: Develop apparatus for separating uranium and transuranic constituents from relatively large volumes of contaminated soil.

DESCRIPTION: Presently the Air Force, and the other services, generates large quantities of depleted uranium-contaminated sand as a result of munitions testing. In the event of a weapons-related accident/incident, large quantities of soil contaminated with transuranics, in particular plutonium, could be generated. With disposal costs for these wastes increasing at an ever faster rate (expected to reach $500.00 per cubic foot or more by 1994), it is imperative that the services reduce the volume of radioactive waste generated to the maximum extent possible. One method which shows some promise of separating depleted

uranium from sand is a method (Patent Number 4,894,134) which uses high power, variable frequency RF energies in selective or rarefied atmospheres to eliminate unwanted impurities from a variety of nonconductive base materials. Phase I would be to explore the feasibility of applying this method to large volumes of sand/soil contaminated with depleted uranium and possibly plutonium. Phase II would be to construct a small-scale prototype industrial process utilizing this technology. Phase III should result in a production model system which can be moved from site to site depending on the need.

AF93-033 TITLE: Collection and Display of Aircraft Information for Environmental Noise Analyses

CATEGORY: Exploratory Development

OBJECTIVE: Develop automated collection of aircraft data for operations around airbases.

DESCRIPTION: The Air Force has installed Secondary Radar Systems named Programmable Indicator Data Processors (PIDP) at 50 of the busiest Air Force bases with plans to install these at another 34 bases. This system gives the Air Traffic Controllers (ATCs) position/airspeed information on all flying aircraft within the controllers' airspace. Currently, there is no interface of this system to any recording device. If the spatial position information provided by the PIDP could be synchronized with the Identification Friend or Foe (IFF) or Beacon code and time of event, and downloaded to a personal computer, software could then be developed to automatically identify the aircraft type and translate positional data directly to a microcomputer for subsequent analysis. This database could be used to derive nominal aircraft flight ground tracks, flight profile altitudes, airspeeds, and track dispersions. This information along with operational statistical data could be input to BASEOPS, a computerized operations input module for airbase noise analysis. Such an automated aircraft operational data record would significantly improve the reliability of inputs presently used for the Environmental Impact Analysis Process (EIAP) and the Air Installation Compatible Use Zone (AICUZ) program. This same aircraft operational database could also be used for particulate and gaseous emissions reporting required in air quality analyses. This new capability would certainly lead to more accurate and defensible noise and air quality assessments that are presented to the public. This topic is intended to provide an opportunity for the proposer to submit ideas directed towards collection of accurate aircraft operations information around airbases for input to environmental analyses. This topic covers areas from hardware interface to a personal computer to statistical analyses of operations count, flight track and altitude dispersions to incorporation of final results into environmental analysis models. A Phase II effort would result in a field tested, fully working computer program and hardware interface that would be used for aircraft operations data collection for compatible land use planning purposes and for either/both noise and emissions environmental impact analyses.

AF93-034 TITLE: CaF2 (EU) Detection and Computer Interface for Radiation Detectors

CATEGORY: Exploratory Development

OBJECTIVE: Develop USAF Radiological Health Laboratory designed probe and computer interface for non-ionizing radiation temperature measurements.

DESCRIPTION: Proposals may be submitted against the specific requirements indicated below. (Specify subtopic by letter)

a. In 1976, personnel assigned to the USAF Radiological Health Laboratory at Wright-Patterson AFB, Ohio, (now Armstrong Laboratory at Brooks AFB TX) designed and produced a calcium fluoride, europium doped, (CaF2(EU)) based scintillation probe for use in making field measurements of low energy radiation from the 17 keV L X-rays from plutonium and the 60 keV gamma rays from americium-241. Several of these probes were subsequently produced. These original probes are still in use, and have proven to be highly sensitive and rugged under all types of field conditions. The goal of this research will be to redesign these probes using state-of-the-art electronics and thereby improve the overall detection sensitivity of the probe. Phase I will develop a specific proposal for improving the original design (original specifications available from AL/OEBSC). Phase II will be to construct and test a prototype of the proposed design using as a minimum ANSI N42.17A standards, and if testing is satisfactory, provide 20 complete probes for use by the Air Force Radiation Assessment Team.

b. Although a probe and system for temperature measurement in Radiofrequency Radiation (RFR) fields are commercially available, there is no interface to standard laboratory computers. The computer interface will provide an easily implemented method for accurate temperature measurements which are used for two purposes in RFR experiments: 1) The temperature of the preparation is, of course, needed to document experimental conditions 2) Initial temperature increase at the onset of RFR is used to determine specific absorption rate. The interface will be constructed using standard hardware components and have

associated software written for its use. It is anticipated that the connection to the probe will be an appropriate analog-to-digital converter. However, a search must be performed to identify devices which facilitate communication with IBM PC compatible computers. Phase I will be a search for appropriate technology to allow computer interface between commercially available temperature measurement systems and standard computer systems. Initial designs will consider direct connection of a converter to the computer, such as the Intersil ICL7109. The search will also identify the most appropriate sensor board for a PC expansion slot. Phase II will produce an interface between temperature probe and computer. This product would be commercially viable in Phase III. The market would be all medical workers and scientists performing thermal measurements in radiofrequency fields, possibly 10-50 thousand if the system is used for medical diathermy.

AF93-035 TITLE: Command, Control, Communications and Intelligence Technologies

CATEGORY: Exploratory Development

OBJECTIVE: Develop Innovative concepts for increasing warfighting capabilities of the Air Force Command, Control, Communications and Intelligence (C3I) systems.

DESCRIPTION: Proposals may address any aspect of AF C3I systems not specifically covered by other SBIR topics. Areas of interest include, but are not limited to C3I concepts for: fixed and mobile command centers; tactical operations; special forces operations; AF ground based or airborne early warning systems; AF mobility issues; mission support system (MSS) planning tools; electronic countermeasures; advanced communications systems and innovative data fusion schemes for C3I sensors. This topic offers great flexibility for proposers to offer solutions to AF C3I problems. Proposal titles must reflect the specific C3I area being addressed.

Phase I: Phase I should accomplish the initial feasibility analysis and develop an implementation and demonstration plan for phase II.

Phase II: Phase II should accomplish a prototype development and/or demonstration.

AF93-036 TITLE: Innovative Approaches to Logistics Supportability

CATEGORY: Exploratory Development

OBJECTIVE: Develop innovative concepts, models and diagnostic tools to advance the logistics supportability of Air Force C3I systems.

DESCRIPTION: There are many opportunities for innovative supportability concepts. Some of these opportunities run concurrently with the development of technologies such as photonics, GaAs, InP etc. Others are to be found by interrelating existing parameters so that new algorithms emerge which more accurately predict supportability of Air Force C3I systems. Proposals to this topic may address any aspect of logistical support to Air Force C3I systems not specifically covered in other SBIR topics. Of specific interest at this time are:

a. The development of supportability parameters (Si-inherent supportability, Sa-achieved supportability, So-operational supportability) and a supportability model to predict the support status of an Air Force C3I system, similar to availability parameters (Ai, Aa, Ao).

Phase I: Develop, define and relate meaningful supportability parameters in an algorithm, preferably a simple algebraic formula, to predict supportability status of a C3I system.

Phase II: Refine algorithm and demonstrate application to various Air Force C3I systems.

b. Development of diagnostic tools capable of identifying and/or predicting failures in electro-optic and photonic systems (excluding the optical fibers themselves).

Phase I: Identify key failure mechanisms in electro-optic and photonic systems/subsystems and propose concepts for diagnostic tools.

Phase II: Develop and demonstrate prototype diagnostic tools.

AF93-037 TITLE: Innovative Approaches to Physical Security Systems

CATEGORY: Exploratory Development

OBJECTIVE: Develop advanced non-intrusive biometric sensors and innovative communication schemes for relocateable security systems.

DESCRIPTION: Innovative approaches are sought to two aspects of physical security.

a. Advanced non-intrusive biometric sensors are needed for access control applications which provide faster, more accurate identification of individuals and require less user interface.

b. Innovative communication schemes are sought which allow individual sensors of a relocateable security system to communicate between themselves and a remote monitoring site without the need for hard wires or fiber optic interconnects. Concepts must provide for reliable, jam resistant communication.

Phase I: During phase I a feasibility analysis of the proposed concept should be accomplished and summarized in a final technical report.

Phase II: During phase II a prototype should be developed and demonstrated.

AF93-038 TITLE: Electromagnetic Shielding for Electronic Equipment Shelters

CATEGORY: Exploratory Development

OBJECTIVE: Develop more efficient electromagnetic shielding concepts for new composite electronic equipment shelters.

DESCRIPTION: Military communications and electronic equipment contained in tactical shelters requires protection from potentially damaging electromagnetic pulse (EMP); electromagnetic interference (EMI); and disruptive radio frequency interference (RFI). Shielding serves a multipurpose function by protecting enclosed equipment from external sources of EM fields while containing emanations from the equipment itself. The shield must attenuate the undesired signals to an acceptable level and electrical continuity throughout the shield must be maintained. Presently, there are efforts to produce a next generation shelter using composite materials which still require EM protection. Therefore, designs must be investigated to provide electrical continuity throughout the shelter. Techniques and materials for establishing EM shielding in composite shelters, improved and more reliable EM gaskets installed at any seam such as a door opening, and techniques of mating the gasket to the shelter EM shield need to be developed. Of particular concern will be to provide shielding at joints, corners and seams, as well as designing concepts that will provide protection at all frequencies of concern.

Phase I: During phase I it is expected that existing materials and/or new material designs, as well as fabrication techniques, to assure required shielding effectiveness will be explored. Alternative gasket designs and mating techniques will also be explored and estimated cost and performance of concepts as applied to an S-280 size shelter will be summarized in a final report.

Phase II: During phase II it is expected that prototype shelter panels, joints, corners and door assemblies incorporating the concepts identified in phase I will be fabricated and tested for EM shielding effectiveness. Prototype gasket designs will be fabricated and mated to the prototype door assembly for life expectancy testing and EM shielding effectiveness.

AF93-039 TITLE: In-Transit Visibility Technologies

CATEGORY: Exploratory Development

OBJECTIVE: A system-of-systems capable of tracking a specific individual or piece of cargo down to its current location.

DESCRIPTION: Air Mobility Command (AMC) has a need to track the real time status and location of planned, in-transit and completed airlift cargo and passenger movements. For in-transit situations a need exists to show aircraft tail number, current location and ETA (if airborne). Proposed systems should: (1) consolidate planned and actual force movement information from defense transportation shipping agencies, unit level transportation offices, mobility and unit move sources; (2) combine DOD wide transportation data with AMC command and control actions; (3) maintain a consolidated track record (both classified and unclassified) of force movement, transportation and C2 actions; (4) make the consolidated information quickly and easily available, in real time, to any AMC user; (5) Provide a single user friendly terminal that performs all navigation tasks through the C2 and transportation communications-computer systems. The User simply chooses the application needed and will no longer need to access multiple terminals and systems to get the information to do their job.

Phase I: Develop a key component of at least one of the tasks listed above.

Phase II: Develop and demonstrate prototypes of key hardware and/or software elements.

AF93-040 TITLE: Cost Benefit Analysis Tool for C4 Information Modelling

CATEGORY: Exploratory Development

OBJECTIVE: Develop a cost benefit analysis tool for C4 systems.

DESCRIPTION: Currently, Electronic Systems Center (ESC) lacks the methodology and tool sets needed to perform a cost benefit analysis of potential alternative solutions of Air Mobility Command's (AMC) command, control, communications and computer (C4) needs. A structured functional/economic methodology and supporting tool set needs to be developed which uses the information modeling data ESC has available to perform cost benefit analysis. The proposed tool must consider the rate of information exchange at execution nodes, be able to compare costs between systems and their benefit to the user's functional requirements, and accomplish functional/economic cost comparisons between possible solutions. Such a tool would be useful to any organization (private or federal) that deals with large quantities of computer managed information.

Phase I: Develop a functional/economic methodology to perform C4 cost benefit analysis and the top level implementation algorithms.

Phase II: Produce prototype software tool to fully implement the methodology developed in phase I.

AF93-041 TITLE: Application of Artificial Intelligence and Neural Networks to Command Centers

CATEGORY: Exploratory Development

OBJECTIVE: Develop an artificial intelligence decision aid to support weapon release strategies at strategic defense command centers.

DESCRIPTION: One of the Strategic Defense Initiative Organization's major human-in-control concerns is the optimum mix of human and machine decision making. Decision aids are needed which can provide the commander with the projected effectiveness of his weapon systems in terms of weapons used, reentry vehicles destroyed and assets saved under various release strategies. ESC has developed a fixed-algorithm prototype decision aid simulation based on stored scenarios and weapon release strategies. What is needed is application of this concept to the real world where a learning system can employ artificial intelligence to analyze the attack in progress and provide the commander with the effectiveness of each of the available weapon release strategies.

Phase I: Design a decision aid system and perform a feasibility analysis of its performance in supporting command centers.

Phase II: Develop and demonstrate a prototype decision aid system.

AF93-042 TITLE: Element Failures in Adaptive Antenna Arrays

CATEGORY: Basic Research

OBJECTIVE: Develop and evaluate a system to automatically detect and locate antenna array element failures and to automatically compensate for failures.

DESCRIPTION: Future radar systems will employ advanced array beamforming techniques to meet stringent operational performance requirements. To insure a state of readiness commensurate with achieving a high probability of mission success, array beam-forming capabilities must include provisions to detect, locate, and correct in real time for the effects of a variety of element failure types. Failures can result during operation from solid state component burnout, battle damage, and EMI or EW induced malfunction in the beamformer control subsystem. Such failures can be partial or total, intermittent or permanent. Near-field techniques developed by Newelland and others are not necessarily appropriate for real time monitoring of array health during normal radar operation. Innovative techniques are needed to detect and correct for element failures such as frozen phase shifters, loss of amplitude and position distortion.

Phase I: A Phase I contract will involve analysis of the distinct array characteristics resulting from different types of element failures. Techniques which can uniquely identify failures in arrays having a modest number of elements (10-400) will be developed. Algorithms are to be formulated to compensate in real time for detected errors in order to restore main beam gain, pointing accuracy, low sidelobe level (40 to 60 dB), and antijam performance.

Phase II: For Phase II, a feasibility system will be designed and implemented to demonstrate the element failure

compensation concept with an existing radar antenna array.

AF93-043 TITLE: Thin Film Real-Time Holographic Materials and Devices

CATEGORY: Basic Research

OBJECTIVE: To develop the growth technology for implementing thin film real-time holographic materials for use in both surface incident (transmission and reflection) and guided wave holograms. The growth process must have potential for monolithic or hybrid-processing compatibility with OEIC device technology.

DESCRIPTION: Develop growth techniques for producing real-time holographic layers which operate at visible to near IR wavelengths and extend state-of-the-art fast response times and high diffraction efficiencies at low optical powers. These high optical quality thin film layers should be capable of integrating in guided wave devices with electro-optical modulators in a material system which is compatible with monolithic/hybrid fabrication of semiconductor electronics and laser diode sources. This program will provide the following: 1) optical quality real-time holographic thin film layers on passive and transparent optically flat substrates (capable of optically recording thick phase transmission and reflection holograms): 2) similar materials for in-plane control and out-of-plane coupling of guided waves for discrete device systems; 3) growth or fabrication compatibility with thin film electro-optical materials for discrete device systems; and 4) both real-time (with variable response time) and permanent (or fixed) holographic element materials technology compatible with monolithic/hybrid OEIC devices. holographic, and electronic characterization is required.

Phase I: Basic optical, holographic, and electronic characterization is required. In-house growth (or direct processing control) of the thin layers is required. Two each best effort optical quality grown samples of both thin film (about 10 to 100 microns thick and 1 centimeter diameter) 1) real-time holographic material and 2) electro-optical material (or holographic material grown on an integrated optics substrate) will be delivered in Phase I.

Phase II: The Phase II growth technology will include response time control and diffraction efficiency control for in-plane and out-of-plane coupling (eg. longitudinal and transverse electro-optical coefficients). This would include the ability to write permanent (or fixed) gratings. In addition, Phase II growth technology will optimize holographic thin films for use with laser diode wavelengths in the red to near IR.

AF93-044 TITLE: Reduction of Environmental Hazards Due to Arsine Gas and Derivatives

CATEGORY: Basic Research

OBJECTIVE: To develop and perfect methods to detoxify arsine gas and its derivatives.

DESCRIPTION: Arsine gas is used extensively in the preparation of many opto-electronic devices and high speed transistors. These devices are of extreme importance in the communication areas and in optical computers. Arsine is a colorless, non-irritating and extremely poisonous gas. The American Conference of Governmental Industrial Hygienists has set 50 parts/billion as the maximum safe concentration for prolonged arsine exposure. Investigations of arsine technology and toxicity have indicated the following: 1. Epidemio-logical research has shown that 25% of the cases of arsine poisoning are fatal; 2. Toxicology investigations indicated death results from nephrotoxicity (kidney failure); and 3. Methods and techniques to detoxify the arsine that escapes the processing methods are severely needed. Information on the methods in practice today is seric ly lacking. This investigation is primarily concerned with the research and development of techniques to detoxify arsine ga' ad derivatives thereof.

Phase I: Phase I will survey the current and possible methods of detoxifying the arsine gases. This will include an investigation of the chemistry of detoxification. The research will attempt to answer the following questions: 1. How can activated charcoal be treated to increase its chemisorption properties for arsine gas? 2. What other absorbing materials can be used for arsine (e.g. molecular sieves, glasses, etc.)? 3. How will the absorbed gases be removed and detoxified?

Phase II: An experimental program will be undertaken in Phase II in order to develop methods of detoxifying arsine gas and its derivatives. These methods should approach 100% efficiency. These methods are necessary for the future of the semiconductor industries.

AF93-045 TITLE: Automated Documentation Generation

CATEGORY: Basic Research

OBJECTIVE: Automated generation of software system documentation from knowledge base representations.

DESCRIPTION: Emerging software engineering technologies enable software systems to be developed using graphical or symbolic representations to formulate system requirements, specifications and implementations. Software documentation however must still be prepared using conventional manual methods. This leads to the all too frequent problem associated with software systems that the documentation does not accurately reflect the actual system design and implementation. There are two fundamental issues which are overcome by the automated generation of software documentation. First, using manual methods, it is impossible to insure that documentation accurately reflects the software system. Second, without automated coordination of software and documentation it is practically impossible to insure consistency. Advances in text generation technology when combined with the capabilities provided with the new generation of intelligent software engineering tools, make it feasible to automate the generation of software documentation from internal representations. The technical challenges of this effort will be to develop a general documentation generation framework that may be adapted to multiple input representations and output documents so that the product will be useful.

Phase I: Phase I shall investigate high payoff areas of application where significant gains in efficiency in acquisition and support of software systems may be achieved. A generation framework design which focuses on these high payoff areas will be produced and documented in a Final Technical Report.

Phase II: Phase II shall develop and demonstrate a prototype document generation framework for an integrated software engineering environment which encompasses the entire system life cycle and is capable of producing multiple types of documents.

AF93-046 TITLE: 60 GHz Coaxial Components

CATEGORY: Basic Research

OBJECTIVE: Utilize 1.85mm connectors to implement 60 Ghz coaxial isolators, noise sources, mixers, and other components.

DESCRIPTION: The 1.85mm connector has advanced coaxial technology through 60 GHz. However, there is a severe lack of available components which utilize this relatively new connector. This means that waveguide must continue to be used. Waveguide is more expensive, larger in size and heavier. In addition, it is not a baseband technology. That is, it has a cutoff frequency below which it does not transmit.

Phase I: A particular component such as an isolator, noise source, mixer, directional coupler, or switch should be proposed for feasibility demonstration as the end product for Phase I. A major technical challenge requiring innovative ideas and approaches will be to achieve maximum performance and bandwidth. For those components where DC to 62 GHz operation cannot be achieved, 60 GHz is the desired center frequency. A low VSWR at all frequencies (including those out of band) is a major technical challenge.

Phase II: Phase II could take this initial component to prototype stage as well as demonstrate feasibility of other components. In addition, Phase II might also begin work with the 1.0mm connector which offers 110 GHz operation.

AF93-047 TITLE: Ultra-Interactive Surface Process System for Combined Millimeter-Wave/Photonic Component Fabrication

CATEGORY: Basic Research

OBJECTIVE: Demonstrate an interactive ultra-high vacuum wafer-level processing system with in-situ analytical capability for fabrication of surface-sensitive integrated heteroepitaxial photonic components and optical circuits.

DESCRIPTION: Although significant advances have been made for photonic devices at the discrete component level, integration of these same components in a circuit results in a performance decrease due to process incompatibilities. This increasing demand for integrating photonic components necessitates the development of an advanced processing system that can accommodate, in-situ, the wide variation in processing technologies required to fully realize analysis and fabrication of complex photonic epitaxial

structures materials, devices and circuits. Modern USAF system requirements are increasingly met only by synergetically combined photonic and millimeter wave subsystems and components. Currently only the III-V semiconductors combine the electrical optical properties to fabricate such devices and circuits on a common substrate. The inability to evaluate surface physics during such processing steps as ion-based oxide removal, monolayer surface stabilization, dielectric passivation, and metallization limits current OEIC technology. The performance of these ultra-high performance opto-electronic circuits depends crucially on the chemical and electrical characteristics of the material surfaces and interfaces between atomic layers. In turn, these characteristics must be determined during the actual device fabrication for optimal performance.

Phase I: Phase I of this program would include the design of an ultra-high vacuum process module with the appropriate functional, in-situ surface monitoring subsystems and the ability to combine this analysis, in the chamber, with elemental III-V materials fabrication techniques. Such an interactive system would greatly augment the current state-of-the-art.

Phase II: Phase II will implement the Phase I design of the system, implement the Phase I design of the system, demonstrate its capabilities and deliver a functional System to RL/ERO for final test and analysis.

AF93-048 TITLE: Database Schema Translator

CATEGORY: Basic Research

OBJECTIVE: Develop mathematical techniques to translate from one data model to another while preserving semantic context.

DESCRIPTION: Data models, (i,e. hierarchical, network, relational, etc.) have been developed to represent information. The structure of a data model provides additional information about the data, i.e. a semantic context. It is often necessary, due to changing requirements, information sharing needs, or performance considerations to replicate information from one database to another. This requires a schema translation capability that preserves the semantic context of the data as well as the data. Traditional approaches to schema translation require the development of specialized application software that is brittle and inflexible. Preservation of semantic context is left to the programmer's implementation skills. More approaches map data models to a "canonical" representation which is reverse mapped to the target data model. Both approaches are inadequate. Semantic context is often lost on completion of the translation process, and the application software developed is extremely expensive and difficult to maintain.

Phase I: Phase I will identify approaches to direct schema to schema translation.

Phase II: Phase II will result in a prototype that can be evaluated in an operational context (such as DIA's Distributed Production Program).

AF93-049 TITLE: Three Dimensional Optical Data Storage Media

CATEGORY: Basic Research

OBJECTIVE: Develop optical memory media which may be employed in a practical memory architecture.

DESCRIPTION: Three dimensional optical data storage devices have not made their way from the laboratory to practical use due to a lack of media which meets all of the necessary requirements for data storage. In the future it will be necessary to have optical memories for electronic computers which can store huge amounts of data (at least 10**12 Bits), at Terrabit data rates and persist for long periods of time at useful temperatures. Media technologies which may be suitable for this application include but are certainly not limited to: bacteriarhodopsin, spiropirobenzan, electron trapping, photon echo, photorefractives and dye polymers.

Phase I: Phase I should identify candidate media and characterize the optical properties with respect to writing energy, recording time, dynamic range, storage density, and crosstalk.

Phase II: Phase II will incorporate this media into an usable architecture.

AF93-050 TITLE: Self-Routing Optical Interconnect Digital Computer Networks

CATEGORY: Basic Research

OBJECTIVE: Develop innovative techniques to eliminate the need for external control in optical switching systems.

DESCRIPTION: Future Air Force digital signal processors will need optical interconnects to handle the large amounts of data generated in a multi-sensor tactical environment. To speed this data flow process within and between digital computers, computer switching systems which allow optically encoded data packets to perform self-switching functions are needed. This in-band type of switching offers greater speed and flexibility than out-of-band architectures which require additional communications channels to perform switching functions.

Phase I: During Phase I, innovative designs for self-switching networks will be developed. The most promising design will be demonstrated via a one-channel engineering development model.

Phase II: During Phase II, working in the Rome Laboratory Photonics Center, a more advanced network will be developed, integrated with a digital computer, and evaluated.

AF93-051 TITLE: Waveform and Vector Exchange Specification (WAVES) and VHSIC Hardware Description Language (VHDL) Modeling Guidelines

CATEGORY: Basic Research

OBJECTIVE: Develop guidelines for creating and using WAVES in a design and test environment.

DESCRIPTION: With the enhancements of Very High Speed Integrated Circuits (VHSIC) technology, DoD systems are emerging with increased performance, reliability and maintainability. As a result of increasing design complexity, the need for affordable and complete testing and life-cycle support is essential. The VHSIC and Advanced Tactical Fighter programs identified these requirements and supported the development of the VHSIC Hardware Description Language (VHDL), for capturing digital design information in a standard, machine-readable, non-proprietary format, and the Waveform and Vector Exchange Specification (WAVES), for describing stimulus and response information for testing electronic hardware. WAVES bridges the gap between design and test by providing the ability to simultaneously represent stimulus and response waveforms and vectors for both simulation and test purposes. Although WAVES and VHDL are accepted IEEE standards, and are the mechanisms to achieve concurrent development of design and test information for life-cycle support, guidelines and recommended practices regarding the use of WAVES and VHDL for electronic system development do not exist. In addition, adequate examples are not available to assist those required to deliver WAVES and VHDL descriptions, as specified in MIL-STD-454, Requirement 64.

Phase I: Phase I will assess state-of-the-art of VHDL hardware design, and document the recommended guidelines that apply to utilizing WAVES datasets for design verification.

Phase II: Phase II will use the recommended practices of Phase I to develop VHDL and WAVES examples which demonstrate the use of WAVES in a design and test environment. A guideline accompanying the examples will give step-by-step instructions on how to create and use WAVES for various design and test applications.

AF93-052 TITLE: Reconfigurable Holographic Filters

CATEGORY: Basic Research

OBJECTIVE: Demonstrate a rapid wavelength-configurable filter for optical surveillance sensors.

DESCRIPTION: Future optical sensors will require multi-band capability to accurately discriminate and identify targets. Current approaches to sensing different wavelengths include multiple aperture systems and sensor telescopes incorporating reflective/transmissive beamsplitters. In the first case, system size-weight-power-complexity increases to cover the wave bands of interest. In the second case throughput is irrevocably reduced by the absorptive and scattering losses that occur in sequential filter components. Holographic techniques hold promise for simplifying these operations, by incorporating in a single component rapidly selectable diffractive gratings for directing or filtering different wavelengths. Electrical or optical selection of different stored holograms could provide high resolution multi-spectral data for a wide variety of applications. Much information could thus be gained from a target over a matter of seconds, with a very compact lightweight sensor package.

Phase I: Select candidate materials with suitable transmissivity and holographic storage characteristics to meet reconfigurable filter requirements. Develop techniques for impressing, and switching holographic gratings several times a second, on the candidate materials. Design a multi-hologram component that can operate at several wavelengths applicable to surveillance.

Phase II: Design and build a laboratory breadboard for demonstrating the feasibility of using reconfigurable holograms

as beamsplitter-type filters. Conduct performance evaluations of these components at visible, mid- and long-wave infrared wavebands. Develop conceptual sensor designs utilizing these holographic elements for terrestrial and space-based multi-spectral sensing applications.

AF93-053 TITLE: Parallel Optical Memory Interconnects

CATEGORY: Basic Research

OBJECTIVE: Study the problem of the design and fabrication of optical memory interconnects for future signal processing interconnect applications.

DESCRIPTION: Possible optical memory architectures of the future necessitate the development of high bandwidth optical interconnect devices. Due to the necessity for high data rates, and memory requirements for computers in the future, optical 3PD memory technology has been identified as one possible solution to this problem. Some architectures for 3PD memory show great promise for on-line memory needs of the future. One problem with the implementation of such devices is in the area of device interconnections. At this time, no electronic or fiber optic bus meets the needs of these devices. Free space interconnects have great potential to correct this deficiency. The interconnects should be dynamically reconfigurable to connect various optical memories: RAM, cache and associative as well as with optical and electronic processing modules. The relative ease of maintenance and extremely high data rates make these interconnects attractive. The greatest difficulty in the implementation of these devices at this time is due to their vibrational sensitivity. For this reason, amplitude independent digital encoding techniques should be studied. Architecture considerations such as environmental isolation and throughput rate should be investigated as well.

Phase I: Phase I should at a minimum provide an analysis of these problems and a plan of action for the development of these devices.

Phase II: During Phase II further work in this area will at a minimum produce a demonstrable architecture.

AF93-054 TITLE: Strained-Layer Quantum-Well Laser Structures for Microwave Applications

CATEGORY: Basic Research

OBJECTIVE: Develop high-gain semiconductor laser structures for direct modulation at microwave frequencies.

DESCRIPTION: The next generation of high speed analog optical links for microwave and millimeter wave transmission require new designs for semiconductor lasers. Laser bandwidths are presently limited by the relatively small differential gain coefficient of bulk material. Development of lasers with bandwidths beyond 25GHz requires a substantial increase in the differential gain coefficient which can be achieved by the incorporation of a structure with quantum confinement, modulation doping and strained quantum wells. These structures can be developed in GaAs or InP based material systems. QW lasers have also shown less spectral chirping, lower threshold current, narrower linewidth, lower noise and less temperature dependence than bulk lasers. Collaboration with a university or large company which has the facilities necessary to fabricate QW devices is encouraged.

Phase I: Phase I will determine the feasibility of developing microwave QW laser structures.

Phase II: Phase II would attempt to develop a quantum-well laser module with demonstrated bandwidth exceeding 20GHz.

AF93-055 TITLE: Large Wafer MOCVD Production System Components

CATEGORY: Basic Research

OBJECTIVE: Define and implement changes to current MOCVD systems that result in a high through put of large diameter wafers.

DESCRIPTION: There is currently an increasing DoD demand for the production of Gallium Arsenide and Indium Phosphide based devices for incorporation into DoD electronic and opto-electronic systems. For very high frequency devices, a low cost/high yield epitaxial growth technology capable of growing on large diameter wafers is required. Metal Organic Chemical Vapor Deposition (MOCVD) is one technique that is thought to be particularly suited for high throughput. However, at the

present time there are no MOCVD production based systems that are capable of uniformly processing 4" and 6" wafers.

Phase I: The Phase I effort should be devoted to researching the process requirements for a 6" MOCVD single wafer system with emphasis on production. Areas to be addressed should include single wafer versus barrel reactors, physical space requirements, effluent handling, etc.

Phase II: For Phase II, novel aspects of the findings found in Phase I should be demonstrated.

AF93-056 TITLE: Pseudomorphic HEMT MMICs by Organometallic Vapor Phase Epitaxy

CATEGORY: Basic Research

OBJECTIVE: Demonstrate the viability of pseudomorphic high electron mobility transistor (HEMT) fabrication for MMIC with metal-organic chemical vapor deposition manufacturing technology.

DESCRIPTION: Although pseudomorphic (PM) HEMT MMICs have demonstrated the best performance of all the device technologies at microwave and millimeter wave frequencies, truly manufacturable HEMT technologies have not yet been developed. As a result, low cost pseudomorphic HEMT circuits and MMICs are not commercially available. This may be in part due to PMHEMT device fabrication being singularly reliant on MBE technology which produces high purity material but is inherently not amenable to multi-wafer manufacturing. This in turn translates to high cost and increased manufacturing time for the MBE technique. In contrast OMCVD technology is capable batch processing but to date the material quality is lacking. In all, enhancing the material purity available from OMCVD could result in considerable overall cost savings for high speed compound semiconductor devices.

Phase I: Phase I of this program should therefore focus on the research of OMVPE or OMCVD of PMHEMT structures to determine suitability for MMIC fabrication.

Phase II: Phase II will demonstrate the growth of PMHEMT wafers with optimum device structures determined in Phase I. Also HEMT circuits such as power amplifiers will be fabricated and compared to MBE-fabricated circuits.

AF93-057 TITLE: Superconductive Technology for Microwave/millimeter Wave Antenna Systems

CATEGORY: Basic Research

OBJECTIVE: The development of superconductive components for monolithic antenna systems.

DESCRIPTION: Recent Accomplishments in low and high temperature superconductivity offer the possibility of significant new advances in monolithic antenna technology for microwave to the submillimeter wavelength regimes. Innovative research proposals for the application of superconductivity include but would not be limited to monolithic microwave, millimeter and submillimeter integrated array applications. Examples of components include oscillators, mixers, filters, isolators, circulators, and antenna feed structures. Electronically variable ways to control power, amplitude and phase or time delay of large wideband phased-arrays are of interest. Innovative wideband, monolithic, phased-array antenna elements are needed which are compatible with thin-film superconducting feeds, are efficient radiators and at the same time provide thermal isolation of the superconductive feed circuits from ambient free-space temperatures. Research to develop sub-systems such as monolithic integrated receivers and frequency synthesizers is required. A/D converters, shift registers and signal processing circuits operating in the giga- to multi-gigahertz regime are desired to advance the state-of-the-art of digital phased array antenna control.

Phase I: A Phase I contract will involve analysis of the theoretical background, and preliminary experiments and tests to clearly demonstrate the technical feasibility of the proposed development concept.

Phase II: A Phase II contract will require the development, test, analysis and conclusive proof of the concept.

AF93-058 TITLE: Formal Verification of VHSIC Hardware Description Language (VHDL) Models

CATEGORY: Basic Research

OBJECTIVE: Develop analysis techniques to utilize existing Formal Verification tools to verify digital hardware designs written in the VHSIC Hardware Description Language (VHDL) .

DESCRIPTION: The driving force for requiring VHDL within the DoD is to reduce the escalating Life Cycle cost associated with device development, testing, maintenance, and re-procurement. To achieve this goal, the DoD now requires that all electronic devices delivered be documented in VHDL. VHDL designs capture the behavior and structure of an electronic system, subsystem, or device, in a machine processable, simulatable, and hierarchical format to be used in all phases of development. However, determining the correctness of a design by exhaustive simulation is not a feasible methodology due to the cost and time required to generate the test and simulate the model. In contrast to simulation, formal verification of hardware is a mathematical proof that the design of a digital circuit satisfies certain properties for every input. Formal verification tools can be used to prove that hardware designs satisfy properties such as functional correctness, safety, security and timing.

Phase I: Phase I will demonstrate the technical feasibility of this effort by selecting a formal verification tool and applying it to a VHDL model of appropriate difficulty.

Phase II: Phase II will identify any barriers between VHDL and the formal verification tool selected and make enhancements to overcome these barriers.

AF93-059 TITLE: Real-Time High Performance Software Visualization Tool

CATEGORY: Basic Research

OBJECTIVE: Develop a software tool to graphically depict the timing of real-time software.

DESCRIPTION: During development of real-time software, the engineer must be sure the software has completed its function before some time period has expired. This time period is called a time constraint on the software, and the time limit is the deadline. These deadlines are of two types, a hard deadline that must be met on every execution of the software, and a soft deadline is one that can be surpassed once in awhile without critical error. Therefore, while developing software for real-time systems the engineer has two major problems to keep in mind, first does the software perform its function before the deadline. Second, will the software meet its deadline if it is ported to another target architecture. In order to determine if a software system has met its real-time deadlines, a more intuitive approach would be to actually see different processes meeting or exceeding their deadlines. This visual depiction makes the information about the processes more comprehensible and easier to understand.

Phase I: Phase I of the effort will concentrate on how the software timings can be depicted in a comprehensible manner, and how such timings can be collected.

Phase II: Phase II will focus on implementing the findings of Phase I in a preliminary tool, and targeting this tool to parallel machines.

AF93-060 TITLE: Software Reliability Assessment for Distributed Systems

CATEGORY: Basic Research

OBJECTIVE: Develop software reliability assessment models for distributed architectures.

DESCRIPTION: With the growth of distributed computing in real time DoD applications, a more sophisticated approach for software reliability assessment which accounts for the effects of replication, concurrency, data dependencies, fault containment (and propagation), fault tolerance, incorporation of commercially available components, components taken from reusable software libraries, and other properties is required. The outcome of this research will be a framework and one or more software tools for developing a composite system-level reliability and availability assessments for a distributed system together with a means of accounting for the effects the expected types of failures.

Phase I: In Phase I, a model framework and a means of adapting one or more established software reliability models to a distributed software system will be developed.

Phase II: In Phase II, the model will be extended to account for other aspects of distributed systems (those noted in the second sentence) and validated using failure data from large real time distributed systems.

AF93-061 TITLE: Ultra-Low-Power Semiconductors for Multi-Chip Modules

CATEGORY: Basic Research

OBJECTIVE: Demonstrate Low-power Semiconductor innovations for use in advanced packaging technologies (e.g., Wafer Scale Integration, Multi-Chip modules, etc.).

DESCRIPTION: These breakthroughs will be required to construct highly dense electronic systems with a power density compatible with state-of-the-art thermal management approaches. The trend in electronics at the component and system level is for ever increasing density. As electronics devices get smaller, they consume less power, but since they are smaller, more of them can fit into a unit area, and hence the power consumed by an integrated circuit does not necessarily decrease with time. With the advent of two-dimensional multi-chip modules (MCMs), and the increasing interest in three-dimensional MCMs, the power density of a system in area and volume is expected to grow quite dramatically. Of course, the heat density goes up approximately at the same rate the power density goes up, so thermal management becomes an inhibiting factor. Two solutions include (1) the introduction of various apparatus to improve the heat removal ability of as-built electronics and (2) lowering the power of the electronics components. While much attention is beginning to be placed in the first approach, relatively little attention has been placed toward the reduction of power in electronics components themselves, other than that which comes about naturally through feature size reduction. We seek more innovative solutions that go beyond, and most eagerly sought after are those solutions which minimize impacts to existing semiconductor fabrication processes. If one could build logic devices, for instance, in an existing process that consumed five to ten times less power, then the dissipated heat generated would be reduced by a similar factor. On a system level, where millions of such devices would be employed the savings translates into improved size and weight and therefore cost due to the reduction of power and heat. In some cases, these ultra-low power devices would enable systems to be built that were previously inconceivable due simply to the inability to place all of the components within proximity due to the heat dissipation problem.

Phase I: A successful Phase I proposal will address the aforementioned concerns in the form of analysis, design, and tests to the maximum degree possible. The groundwork for lower power devices that achieve approximate density parity to devices built in the current state-of-the-art must be clearly established.

Phase II: In Phase II, we will request that a demonstration system be constructed to prove that ultra-low power device technology is possible. This Phase II system will be compared against a conventional version of the same system to fully quantify the advantages of the proposed approach.

AF93-062 TITLE: High Input/Output Pin Count Advanced Electronic Package

CATEGORY: Basic Research

OBJECTIVE: Develop survivable, high input/output bandwidth packages for simple and compound multi-chip modules and wafer scale integrated circuits.

DESCRIPTION: These multi-chip modules and integrated circuits must meet the high performance and reliability requirements of future military systems. The number of signals and power conductors required to service single and multi-chip packages has grown steadily since the inception of the integrated circuit itself. Contemporary solutions for military electronics are limited to those which provide a hermetic barrier separated the components from the environment. The associated packaging approaches, which are usually based on peripherally distributed pins or pin grid arrays, are inadequate in addressing the growth expected in pin count over the next five to seven years. Even pin grid arrays, which are currently used to achieve pin counts of nearly 400, create more problems than they solve at pin counts much higher than this. As such, superior packaging approaches are required, ones that provide the ability to hermetically enclose electronics and still provide large numbers of high-performance signal (to 3000 Mhz and beyond) and power interconnections between the enclosed components and the next higher level of packaging. At the same time, to preserve the density advantage of two- and three-dimensional multi-chip modules, this superior package must support highly efficient thermal transfer and "tile packaging" (the ability to arrange packages in avery spatially efficient manner onto a planar wiring board). Needless to say, these packages must endure ground, air, and space environments, and perform reliably in mechanically and thermally rugged environments. The package should in no way compromise the radiation survivability of the components enclosed. And, believe it or not, this package should also be economically effacious, as much as one would expect based on the cost trends of packaging since the 1970s.

Phase I: Clearly address the aforementioned issues through a superior package design with as much groundwork in analysis and test as possible. Leveraging into the infrastructure is important, and as such the package features (size, for example) should comply, where reasonable, to existing and emerging government and industry standards.

Phase II: The Phase II program will construct and comprehensively test prototype packages that are expected to closely resemble (if not coincide with final products). The packages shall be evaluated with thermal simulation substrates (package mockups with distributed heat elements) for thermal performance. They also shall be evaluated in various test conditions (e.g.,

highly accelerated stress tests and conventional MIL-STD-883 "shake, rattle, and roll" tests) for physical and electrical interconnect integrity (from dc to 800 MHZ pulsed digital waveforms). The conclusion of Phase II would provide many interface opportunities with various military and space projects that will require superior package solutions.

AF93-063 TITLE: Integrated Circuits & Multi-Chip Modules: Space Qualified, Radiation Hardened Optoelectronics Interconnect

CATEGORY: Basic Research

OBJECTIVE: Develop and demonstrate a highly compact, space qualified, radiation hardened optoelectronic interconnection capability for use with multi-chip modules.

DESCRIPTION: These multi-chip modules and integrated circuits are intended for use in analog and digital high-performance electronic systems. Since the first integrated circuit, the signal bandwidth requirements of integrated circuits have climbed steadily from 14-16 signals to over 400 signals. Based on this trend, some have estimated that as many as 10, 000 high speed signals will be typical in systems by the year 2000. The advent of multi-chip modules has done nothing but exacerbate this problem since they contain up to several dozen complex integrated circuits. Clearly, new solutions will be required to handle the interconnection bottleneck that may occur if only wire-based solutions, which have a very limited expansion capability, are pursued. Optical interconnections between multi-chip modules (MCMs) will provide greatly improved interconnection capability and therefore higher performance for future space systems.

Phase I: A prospective Phase I effort will assess current trends in electronic packaging, including two- and three-dimensional MCM and WSI technologies and will demonstrate optoelectronic concepts that can be physically scaled for inter-MCM signal interconnections. Innovative solutions are sought not just for digital MCMs, but for analog and mixed-signal applications.

Phase II: The Phase II effort will demonstrate the practical application of a compact, survivable, and reliable compound MCM system that demonstrates the enabling benefits of optoelectronic interconnections. A successful Phase II effort would pave the way for transition to candidate user applications.

AF93-064 TITLE: Electrode/Electrolyte Interfaces in Solid State Polymer Electrolyte Cells

CATEGORY: Basic Research

OBJECTIVE: Investigate electrode/electrolyte interfaces in solid state battery cells and develop methods to reduce degradation of the interface region.

DESCRIPTION: There is a need within the Air Force to develop secondary batteries with high energy density and long cycle life for use on military satellites. Doing so will decrease the weight of satellites, thus saving on launch costs, while increasing overall satellite lifetimes. Solid state polymer electrolyte batteries have the potential to offer energy densities that are 4-5 times greater than current batteries. However, solid state batteries currently suffer from a number of problems that limit their life cycle capabilities. One of these problems is the degradation of the interface region between the electrodes and the electrolyte leading to premature cell failure. It is proposed that a program be undertaken to address the basic issues and processes at work in the electrode/electrolyte interface and develop an approach for improving the stability of this region.

Phase I: Phase I should concentrate on identifying the processes at work in the interface region and how they impact the overall integrity of the region. A methodology for solving these problems should also be formulated.

Phase II: Phase II will concentrate on applying the methodology/processes identified in Phase I and the fabrication and testing of benchtop cells utilizing these proces.es.

AF93-065 TITLE: Advanced Cryocooler Components

CATEGORY: Basic Research

OBJECTIVE: Develop advanced technology components generic to current cryogenic refrigeration systems.

DESCRIPTION: These new components shall be utilized to improve performance, life, reliability, producibility, and/or cost effectiveness of cryogenic refrigeration systems for spacecraft applications. Current technology is based on cryogenic refrigerators such as linear Stirling cycle, linear drive Pulse Tube, rotary turbo-dynamic reverse Brayton cycle, thermo-chemical and thermo-physical sorption compression Joule-Thomson cycle, and linear drive mechanical compression Joule-Thomson. Analysis of these various cycles discloses that there are generic sets of component technology common to several of these devices. Rather than concentrate on a singular refrigerator design and development, the intent of this project is to promote the development of advanced technology generic components. Given the improved components, improved total system can be subsequently integrated and demonstrated.

Phase I: During Phase I, the design process applicable to the specific component proposed for investigation will be prepared and typical implementations analyzed.

Phase II: During Phase II, representative samples will be fabricated, fully characterized, and subjected to demonstration testing. Examples include; linear flexure bearings, linear motors, position sensors, non-contacting reciprocating sleeve and position assemblies, and servo controlled electronic power supplies are all used in linear drive Stirling cycle, Pulse Tube, and Joule-Thomson cryogenic refrigerators. Check valves are common to all Joule-Thomson devices. Regenerators are common to Stirling and Pulse Tube machines. Recuperators are common to reverse Brayton and Joule-Thomson machines. Turbine and compressor assemblies of the reverse Brayton cycle machine exhibit common technology in the wheel and nozzle designs, the bearing assemblies, and the motors and alternators. Cryogenic triple point phase change periodic heat sinks (at 120 K and 140 K) and cryogenic thermal switches are examples of system components which can be applied to most cryogenic refrigeration systems regardless of the specific cycleutilized.

AF93-066 TITLE: Passive Sensor System Payload Models and Simulation

CATEGORY: Basic Research

OBJECTIVE: Develop models and simulations of space based electro-optical sensor payload millimeter/microwave passive sensor payload, and spacecraft bus vehicle.

DESCRIPTION: These simulations will be separately developed and later integrated into a multi-payload system simulation. The passive sensor simulation and host vehicle simulations will include all subsystems needed for the simulations of passive sensors suites and the host vehicle. The simulation will be used to identify critical path technologies by providing a framework for evaluating various system alternatives and to allow hardware to be incorporated into the simulations to evaluate actual subsystem performance. The contractor shall design the model of the space based electro-optical surveillance payload, millimeter/microwave passive sensor payload, and the host spacecraft bus vehicle and identify quantitative measures of effectiveness that may be used to evaluate performances of the passive sensor payloads and bus vehicle simulation. These models and the effectiveness analysis tools will be used to identify the subsystems to be simulated and to develop general purpose interface specifications for the payload systems and associated subsystems and spacecraft host bus simulation. The interface specifications and subsystem models will be suitable for rule-based, hybrid (combinations of rule-based/waveform), comprehensive emulations. A critical feature of the models, simulations, and interface will be the ability to incorporate hardware and operational data into the simulations. The contractor shall provide recommendations of computer equipment to host the simulations, required training and minimum staff necessary to operate and maintain the simulations. The effort will incorporate government owned subsystem simulations and performance data where appropriate and available.

Phase I: Deliverables shall include a system design for the model, interface specifications for the model, and recommendations for computer equipment software, training and staff needed to operate and maintain the simulations.

Phase II: This phase will be to code the simulation of the space based passive sensor subsystems, host vehicle, and effectiveness analysis tools. The simulations will be rule-based (simple relationships to describe system and subsystem performance) models. Incorporation of government owned simulations in encouraged. Suitability of the simulation, interface specifications, and suitability of the analysis tools will be emphasized.

Phase III: This phase will refine the rule-based passive sensor simulations and host vehicle into comprehensive emulations and incorporation of hardware and operational data info the subsystem simulations. A key objective of this phase will be the success and suitability of integrating the passive sensor simulations, host vehicle simulation, and government owned simulations into unified system simulation. Suitability of the simulation, integration, interface specifications, simulation runtime, computer equipment performance, operation and user interface, and effectiveness of the analysis system will be emphasized.

AF93-067 TITLE: Radiation-Hardened Silicon Charge-Coupled Device or Alternate Visible Detector

CATEGORY: Basic Research

OBJECTIVE: Develop silicon charge-coupled devices or alternate visible detectors that are hard to proton and other radiation.

DESCRIPTION: Charge-coupled devices are very useful for space-based space surveillance and a variety of imaging applications due to their high sensitivity, low noise and high operating temperature. The most critical technological issue in the use of silicon charge-coupled devices is their vulnerability to nuclear radiation. Even a few kilorads of low-energy protons can cause serious degradation in the charge transfer efficiency, and also increase the dark current of the charge-coupled devices, and thus reduce their surveillance and imaging capabilities. The total doses needed to cause the above damage are easily accumulated in the course of a few months in the space environments encountered in mission orbits passing through the Van Allen belts. In order to improve the radiation hardness of the silicon charge-coupled devices or alternate visible detectors, it is essential to develop a detailed understanding of the damage process. The damage should be experimentally studied as a function of proton and other radiation energy, flux density, temperature, and pixel size. Theoretical analysis should be made with the help of computer codes such as Transport of Radiation in Matter. From these, a detailed understanding of the proton and other radiation induced damage in silicon charge-coupled devices or alternate visible detectors should be developed and recommendations made to increase the hardness.

Phase II: In Phase II, prototype silicon charge-coupled devices or alternate visible detectors, with increased hardness, should be developed based on the findings of Phase I.

AF93-068 TITLE: Carbon-Carbon Joining Technology for Space Structures

CATEGORY: Basic Research

OBJECTIVE: Develop methods and techniques required for joining Carbon-Carbon Space Structures using elevated temperature brazing technology.

DESCRIPTION: Carbon-carbon composite components, like other structural members, much be joined to create useful space structures. The manner in which these processes of joining and assembly are performed is generally the determining factor in the structural efficiency and suitability of the overall component. Critical deficiencies in available techniques for joining of carbon-carbon composite components severely limit their application to space structures. Development of braced carbon-carbon joining technology will offer the following immediate benefits: (1) reduced weight/mass/volume of joined carbon-carbon structures (parts such as bolts, nuts, and other fasteners can be eliminated), (2) elimination of the stress concentration problems associated with the holes required for mechanical joining schemes, (3) fabrication of tough high-strength joints, (4) ability to join carbon-carbon without degrading the oxidation protection coating, (5) resistance to thermal shock and thermal fatigue failure modes, (6) ability to form gas-tight joints, and (7) ability to join carbon-carbon to other materials, including metals, ceramics and composites. Novel techniques are needed to enable joining of carbon-carbon composites for application to space structures.

AF93-069 TITLE: Autonomous Neural Control of Space Platforms

CATEGORY: Basic Research

OBJECTIVE: Apply neural network technology to the system identification and structural control of autonomous space platforms.

DESCRIPTION: The benefits of developing space platforms with decreased dependency on ground monitoring and support include reducing the need for ground communication and intervention, reducing the amount of required a priori knowledge of the behavior of the space structure by allowing on-orbit system identification and adaptive control of the structure, and on-orbit health monitoring and recor gurability of sensors and actuators. Existing adaptations of neural networks to control systems have been characterized by ad hoc design approaches which have been highly dependent on the particular system to be controlled. An understanding of the dynamic of neural networks has also been limited.

Phase I: This phase will consist of determining the network architectures and learning schemes which are most successful for system identification and structural control problems, developing systematic techniques for selection of neural controllers

which are appropriate to the given system of interest, and designing a rule-based control architecture which incorporates task-specific neural networks into an overall control system framework. A preliminary demonstration of the feasibility of this technology would also be conducted in this phase.

Phase II: Would involve a refinement of the software implementation of these methodologies and a hardware demonstration of them on an existing precision space structure testbed.

AF93-070 TITLE: Missile Payload Vibration Isolation

CATEGORY: Basic Research

OBJECTIVE: Develop active/passive isolation system to isolate a spacecraft from a launch vehicle to reduce spacecraft dynamic loads.

DESCRIPTION: The design of a spacecraft requires knowledge of structural loads generated almost entirely due to motions induced by, and dynamic interactions with, the launch vehicle. These loads are primarily inertial, highly transitory, and are functions of the spacecraft, the launch vehicle, and external forces. Consequently, the design process is highly interactive. Various design procedures have been implemented to limit repeated analysis of coupled dynamic loads during spacecraft design evolution. However, a comprehensive spacecraft isolator design procedure has not emerged despite extensive commercial development of isolator technology in recent years.

Phase I: Phase I of this effort will formalize, and provide supporting analysis for an innovative isolation system. A survey will be performed to demonstrate the innovative nature of all major components of the proposed system.

Phase II: Phase II will demonstrate system effectiveness for representative payload and launch vehicle configurations through critical component hardware testing coupled with additional analysis and simulation. Phase III will provide a commercial payload-launch vehicle isolator system for flight demonstration.

AF93-071 TITLE: Intelligent Spacecraft Reprogrammability

CATEGORY: Basic Research

OBJECTIVE: Develop the capabiliiy to reprogram on orbit satellite expert systems with a minimum of uplinked code.

DESCRIPTION: Current satellite systems and associated software have limited flexibility to cope with onboard hardware failures and to utilize disparate sensor data to infer failure mechanisms. The ability to modify the onboard information base for expert systems is needed to enhance space systems autonomy and expand the flexibility provided by expert systems. Management of onboard resources is mission and mode dependent; e.g., satellite users may choose to accept a shortened useful lifetime in order to obtain maximum performance in a high level of conflict situation. Autonomous spacecraft must be able to adjust space system performance for various mission critical modes by managing available spare resources and expendable even in the presence of faults. The software supporting this capability must be reprogrammable from the ground in the event of depletion of expendable or subsystem failures to maximize mission performance within remaining resources. Techniques for reprogramming should address less than total update of rule bases or cases verification and validation of uplinked code, use of existing telemetry capabilities of the Air Force Satellite Control network, and operation of there programmable computer module within the 1750A architecture. A goal for reprogrammability is to minimize ground contact time.

Phase I: Phase I will research the modes and architectures by which to update onboard software to add anomaly derived information and to compensate for degradation in mission performance of the spacecraft.

Phase II: Demonstrate reprogramming capability based on the approach developed in Phase I. The reprogramming technique will be demonstrated on the ground using a workstation simulation of a 1750A spacecraft computer.

AF93-072 TITLE: Diamond Coated Insulators for Plasma and Microwave Devices

CATEGORY: Basic Research

OBJECTIVE: Measure the protective and insulating properties of diamond coatings on surfaces exposed to high temperature plasmas and electric fields.

DESCRIPTION: The recent availability of Chemical Vapor Deposited (CVD) diamond and diamondlike coating technology makes its use in many plasma and microwave devices economically feasible. Insulating surfaces in many such devices, such as current feed through insulators, dielectric wave guides, and microwave windows, are often exposed to ultraviolet, x-ray, or particle radiation, high electric fields, or contact with high temperature plasma. The resultant electrical breakdown, ionization, and erosion of the insulator surface often terminates proper current delivery, limits device lifetime, or introduces undesirable impurities into the system. A CVD polycrystalline diamond surface may, in such applications, be the ideal choice for such insulators. Diamond has the highest dissociation temperature of any material and the material that does ablate (carbon) has a low atomic number (Z), lessening the effects of impurity radiation energy losses for hot low Z plasmas. Diamondlike surfaces, though less refractive than true diamond coatings, may be applied over larger areas and to a wider variety of materials, such as plastic, so should be considered a viable alternative. Two devices used by Phillips Laboratory (PL) whose longevity may be increased by the technology are ignitron and spark gap switches. One experiment whose performance may be enhanced by a reduction in high Z impurities is PL's Working Fluid Experiment (WFX). Large plastic current feed through insulators, such as those used on PL's MARAUDER compact toroid acceleration experiment, could benefit from a diamondlike coating in terms of longevity and contaminant evolution.

Phase I: Phase I will involve the measurement of fundamental properties of diamond coated surfaces pertinent to the application. The maximum surface electric field prior to the breakdown of a coated cylindrical insulator sandwiched between electrodes when exposed to various levels of ultraviolet radiation and background gas pressure could be measured using techniques which have been applied to more conventional materials (for comparison). The effects of commonly used surface conditioning techniques such as high temperature baking and glow discharge etching on these properties could be determined. Surface erosion rates and properties such as ablation species and susceptibility to tracking could be studied by spectroscopy, microscopic examination, and weighing, for example.

Phase II: Phase II could involve the fielding of coated insulators in actual devices whose performance or longevity are known to be effected by insulator properties. Device candidates selected for testing will be based on which show the most promise for improvement, based on Phase I results. Phase III could involve the development of the manufacturing techniques for the economical application of the technology on a commercial scale.

AF93-073 TITLE: Model-Based Object Identification & Multisensor Fusion of Images of Satellites

CATEGORY: Basic Research

OBJECTIVE: Develop model-based process for fusing radar, visible, and infrared wavelength signature data of satellites to support identification and assessment.

DESCRIPTION: Phase I effort will explore and plan the process for an interactive model-based graphical means of fusing or merging radar, visible, and infrared wavelength image data of a satellite to support identification and updating or construction of an "as-is on-orbit" computer model of the satellite being imaged. Currently, there is no such process that exploits multiple sensors and is coupled to an integrated satellite model construction algorithm. This proposed process is intended to provide synergistic information that will substantially help answer possible questions about the satellite such as geometric configuration, orientation, surface temperature, and material properties. The nucleus of this model-based fusion process would be an interactive computer algorithm that would take the latest available model of the satellite as input and construct an updated or more detailed model based on the multisensor data input. The model-based fusion process must be capable of handling an initial computer input model with some or no initial information. This study will focus on sensor data from ground site locations for the wide band radar (Inverse Synthetic Aperture Radar - ISAR), visible, and infrared wavelength sensors engaged with satellites in low earth orbits. The satellite model construction algorithm shall be compatible with the International Graphics Exchange Standard (IGES).

Phase I: Phase I efforts will include exploring, planning, and designing the interactive model-based graphical process.

Phase II: Involves the actual implementation of the Phase I plans on a computer graphics workstation, application to simulated radar, visible, and infrared wavelength images of satellites viewed from ground sites, and the demonstration of the satellite model construction process on the workstation based only on input image data. Varying amounts of distortion shall be introduced into the image data to determine there obustness and range of applicability of the newly developed fusion process. Distortion due to such things as diffraction effects overlong ranges, atmospheric distortion, residual phase distortions of atmospheric compensation systems, sensor noise contributions, and background noise shall be considered and factored into the fusing of the simulated images. Phase III may provide follow-on system development and transition to the Air Force Space Command.

AF93-074 TITLE: High Current Cathodes Without a A-K Gap Closure

CATEGORY: Basic Research

OBJECTIVE: Develop a material to provide electron current densities less than 1000 A/sq. cm. at electric field stresses less than 70 KV/cm.

DESCRIPTION: Phase I, effort will be directed towards determining field stress applied to the cathode, current density of the electron beam, and the gap closure rate as a function of field stress. The cathode material must provide 2 to 5 kA of current in a 5 cm radius solid beam when a 150 to 200 Kv pulse is applied to a 4 cm anode-cathode gap. The pulse width must be greater than 1 microsecond and operate in poor vacuum (pressure greater than 1. E-5 Torr). These parameters are to be demonstrated for single pulse operation. Phase II, emphasis will be toward expanding the operating parameter range and determining the number of shots (lifetime) from a single cathode without any loss of performance. The expansion of the parameter space includes higher field stress (eg 500 Kv across 6 cm), higher current density as is required for an annular electron beam (e.g. of order 1kA/sq.cm.), with a minimum pulse width of 1 microsecond. The material must allow at least 10 repetitions of 100 pulses/sec in 10 seconds without significant degradation of the vacuum pressure (as is seen with velvet). Phase III will emphasize engineering modifications for improved lifetime and repetition rate performance. Additionally, the ease of manufacturing and variation in the diode geometry must be addressed for varied applications.

AF93-075 TITLE: Improved Modeling of Bauschinger Effects in Plastic Flow

CATEGORY: Basic Research

OBJECTIVE: Extend validity of the current material plastic model essential for hypervelocity impact and orbital debris collision predictions.

DESCRIPTION: Accurate modeling response of materials used in space structures to high impulsive loading is central to the survivability assessment of space assets to kinetic impact and orbital debris. The typical plastic material model commonly used in predictive structural models, such as that of Johnson and Cook (Ref 1), assumes isotropic hardening. That is, the yield stress in any direction is the same and increases the same amount in every direction due to plastic flow. The assumption of isotropic hardening for nonhomogeneous material is an over simplified assumption which clearly contradicts the Well-Known Bauschinger effect (Ref 2). It can be shown that, alternate tensions and compressions do not result in isotropic hardening. A tension results in the material being softer to a subsequent compression, not harder. In turn the material is softer to the following tension, not harder. The Bauschinger effect is quite relevant to assessment of response of materials to hypervelocity impact and orbital collision phenomena. In a hypervelocity impact event, a shock wave first produces a compressive pulse in the target and impactor. The compressive wave changes to a tensile wave upon reflection from a free surface, and therefore, the conditions for the Bauschinger effect are fulfilled in impact problems. Most material response codes do not allow the Bauschinger effect. Research efforts in viscoplastic (Ref 3) flow models have explored the effect, but not systemically, and not for materials and parameter regimes of interest to impact problems. To realistically predict the response of materials used in space structures, it is imperative to develop a realistic and experimentally verifiable plastic flow model.

Phase I: Design and begin development of a code which models the Bauschinger Effect in plastic flow.

Phase II: Complete development and demonstrate the modeling code designed in Phase I.

AF93-076 TITLE: Laser Modulated Fiber Optic Link

CATEGORY: Basic Research

OBJECTIVE: Develop a laser modulated analog fiber optic instrumentation link for use in high int3nsity electromagnetic environments.

DESCRIPTION: Currently fiber optic links are used to transmit analog signals measured on cables and electronics within weapon systems when exposed to high intensity electromagnetic fields. These signals are transmitted to recording systems in well shielded enclosures located several hundred meters from the test object by means of wideband analog fiber optic links. These links are currently capable of operating over a frequency range from a hundred kilohertz up to one gigahertz with a signal to noise ratio or dynamic range of thirty to forty decibels. Related work in the telecommunications industry has developed laser

pumped Erbium doped fiber optic repeater amplifiers for long haul fiber optic transmission lines. The purpose of the Phase I effort is to investigate and demonstrate in the laboratory the feasibility of using the repeater amplifier technology as a means to provide analog modulation of the fiber optic link from an external signal rather than the current method of injection into the fiber. The goal is to improve the performance both in frequency response as well as overall dynamic range. An alternate application would be amplification of the injected signal to produce a higher gain with reduced noise levels. The external modulating signal could consist of a single pulse or multiple pulses. The frequency range of interest is from approximately one megahertz to five gigahertz. The signal levels of interest are on the order of tens to hundreds of milliamperes or several volts. The dynamic range and fiber optic link length should be consistent with those described above.

Phase I: Phase I efforts include a laboratory feasibility demonstration of the laser modulated analog fiber optic instrumentation link.

Phase II: Phase II effort will provide for limited testing of a prototype system in an actual electromagnetic test of a weapons system. Phase III will provide a rugged system capable of transition to Air Force advanced electromagnetic threat test programs and hardness surveillance testing. Alternate applications for this technology will also be explored during this phase.

AF93-077 TITLE: Combination Microwave Circuit Analysis and Coupling Code

CATEGORY: Basic Research

OBJECTIVE: Develop computational software that calculates the RF energy which couples into an aerospace asset and the response of its electronics.

DESCRIPTION: The Phase I effort will be research of possible method of combining High Power Microwave (HPM) coupling and circuit analysis computer simulations and selecting at least one for further exploration and implementation. This method must demonstrate the ability to meet the USAF's need for a way to calculate time-dependent response of an aerospace asset's electronics when exposed to a fast rise-time pulse of radio-frequency (RF) energy from the outside. An asset's susceptibility to high power RF energy is determined by several factors: the nature of the incident energy (pulse length, total energy, pulse shape, etc.), the loss or gain of the energy as it leaks into the asset (due to physical coupling through slots and holes and the characteristics of antennas or other sensors that give the energy a path in), the loss or gain of the energy as it couples onto circuit boards or cables inside the asset, and finally the response of circuits and individual devices to the energy as it finally reaches the electronics. These gains and losses can be summed up in a general transfer function that is dependent on the characteristics of the incident HPM. Currently the USAF does not have a way to simulate both this coupling and the response of the electronics at the same time. Much of an asset's susceptibility can be tied to the response of a few components that are connected to antennas directly or that are vitally important to its operation. While simulation cannot replace asset experimentation, it can reduce costs by predicting trends that can aid test planning and shorten experiments, and by simulating the application of expensive hardening techniques to judge their effectiveness without actually placing them on the asset.

Phase I: The Phase I effort will consist of researching possible methods and down selecting to the best approach in combining HPM coupling and circuit analysis computer simulations.

Phase II: Phase II will implement the demonstrated method into a usable code for the government. The code must be able to model different assets, including missiles, aircraft, sensor pods and external ordinance. Coupling paths should include antennas and other sensors as well as physical apertures like hatches, slots, and radomes. As part of this effort, comparison with simple experimental results is necessary to further validate the computer simulation technique. Phase III should be a transition of the methods and the code to the civilian sector, with the basic technique modified to work with many applications such as EMC/EMI analyses. Further development will be necessary to meet these other needs.

AF93-078 TITLE: Automatic System for the Detection of Microwave Related Personnel Hazards

CATEGORY: Basic Research

OBJECTIVE: Develop a self-contained, portable, compact device for use in monitoring and detecting the presence of potential electro magnetic radiation hazards.

DESCRIPTION: In recent years, there has been a substantial increase in the variety and output power of pulsed RF and microwave sources used for electronics effects testing, along with the increased tendency to utilize experimental sources as soon as they are developed. Research-type ultra-high power sources often exhibit unwanted levels of radiation both in inconvenient

directions and from unexpected locations. Assessment of whether such radiation exists, and whether or not it is safe, can become a frustrating and time-consuming procedure, which, at present, must be customized to the type of RF source involved. An RF detection system which is capable of rapidly and accurately discriminating between safe and hazardous radiation exposure conditions over a broad frequency range, regardless of the nature of the source(s) involved, is required.

Phase I: Phase I work should identify specific innovative methods for the experimental detection and discrimination of RF/microwave hazards, and demonstrate the feasibility of developing a portable RF/microwave hazard detector.

Phase II: Phase II work should implement the concept developed in Phase I, and demonstrate the availability of the prototype device to detect and react to a variety of hazardous RF conditions.

AF93-079 TITLE: High-Power Semiconductor Laser MOPA Configurations Operating at 2-5 Microns

CATEGORY: Basic Research

OBJECTIVE: Develop diode laser source in a master oscillator/power amplifier (MOPA) configuration which operates in the 2-5 micron (mid-infrared) regime.

DESCRIPTION: Semiconductor laser diodes are currently being developed to operate in the mid-infrared (MIR) wavelength range from 2-5 microns. These lasers are made from the InGaAsSb, HgCdTe, and pb-salt material systems and typically have double-heterostructure (DH) active regions. Because of the narrow band gaps and valence band structures of these materials, losses due to non-radiative processes, such as Auger recombination and free-carrier absorption, are high. Therefore, MIR semiconductor lasers currently have very limited power output. Once those problems have been addressed, the power will still be limited by gain stripe width and catastrophic facet damage. One solution to this problem is to use a low-power MIR laser as a master oscillatory, then amplify the output via a separate power amplifier. Broad-area semiconductor optical amplifiers have been successfully demonstrated in the GaAs/AlGaAs material system, where nearly diffraction limited outputs of 12 Watts were reported. Because of the absence of feed backing these devices, large areas of the amplification medium can be used to amplify the output of the master oscillator.

Phase I: This effort shall explore the implementation of a MOPA configuration in MIR materials. The investigation shall address both high power output and good beam quality, as well as identifying any limitations to these goals. Once a suitable material system and design are identified, all growth, fabrication and material processing requirements necessary to implement the MOPA device (including both the master oscillator (laser) and the power amplifier) shall be addressed. Any unique optics necessary to implement the design shall also be identified.

Phase II: Phase II shall implement the Phase I design and develop a MIR diode laser MOPA device. This development will include the growth or purchase of epitaxial material, processing, testing and characterizing the devices. The test results and the MOPA devices will be deliverable at the end of Phase II. The technology developed has direct impact on the critical Air Force problems of Strategic Relocatable Targets, Secure Optical Communications, and Optoelectronic Warfare. Other USAF and commercial applications of this technology include optical communications, heterodyne detection, and high-resolution molecular spectroscopy.

AF93-080 TITLE: Low-Dimensional 2-5 Micron Semiconductor Lasers

CATEGORY: Basic Research

OBJECTIVE: Design and model diode laser structures with quantum-well, quantum-wire, and quantum-box active regions operating at 2-5 microns.

DESCRIPTION: Semiconductor laser diodes are currently being developed to operate in the mid-infrared (MIR) wavelength range from 2-5 microns. These lasers are made from the InGaAsSb, HgCdTe, and Pb-salt material systems and typically have double-heterostructure (DH) active regions. Because of the narrow band gaps and valence band structures of these materials, losses due to non-radiative processes, such as Auger recombination and free-carrier absorption, are high. QW lasers have been demonstrated which have lower thresholds and higher operating temperatures than their DH counterparts, which is due in part to the reduced Auger rates in the QW compared to the bulk. The reduced Auger rate in QW's is related to several factors, such as: (1) the reduction of allowed intraband transitions which conserve energy and momentum, and (2) the narrowing of the spectral gain curve as a result of the step-like density of states (DOS), which reduces the number of carriers above the threshold energy for the process. In quantum wire (quantum-well wire, QWW) or a quantum box (QB), the energy- and

momentum-conserving transitions will be limited further by the additional quantization in the additional dimensions. Also, the one-dimensional DOS of the QWW will also reduce the spectral gain curve further because of the high density (infinite in the ideal case) at the bound energy levels. Likewise, the QB DOS is singular at the bound levels, so the width of the gain curve is infinitesimal when broadening mechanisms are neglected. All these factors should resulting lower thresholds and higher operating temperatures in QWW and QBlasers due to lowered Auger recombination probabilities. The fabrication of QWW's and QB's is a problem that is currently being addressed in two general ways, namely lithography and controlled growth. The former is accomplished by either etching the structure to form small lateral dimensions, which results in surface problems that are difficult to deal with, or the lateral structure can be defined by selective intermixing of the QW's. In this technique, impurities or other defects are introduced to the QW's in regions outside the QWW/QB regions where they induce disordering of the QW's during an annealing step. In controlled growth, the QW material is grown on a patterned substrate which causes thickness variations in the lateral dimensions, or vicinal growth of the QW material is done on and off-axes substrate. These techniques have been studied using GaAs-based materials with varying levels of success.

Phase I: Select a material system in which quantum structures can be fabricated, define a technique to realize quantization in the lateral dimensions, and model various laser diode structures using QW's, QWW's, and QB's in the active regions. The lasers shall be designed for room-temperature operation in the 2-5 micron range, and modeling of the device shall include the effects of QW's, QWW's, and QB's on the Auger recombination rates well as other parameters (such as other non-radiative effects, threshold current, output power, etc.). The emphasis in Phase I is on the theoretical modeling of QW, QWW and QB diode lasers in MIR materials.

Phase II: Apply the concepts and designs of Phase I to the QWW fabrication. The lateral quantization technique shall be supported by experimental verification. The models developed in Phase I shall be refined as experimental data is acquired from the fabricated QWW's and QB's. The actual computer model will be deliverable at the end of Phase II. The technology developed has direct impact on the critical USAF problems of Strategic Relocatable Targets, Secure Optical Communications, and Optoelectronic Warfare. Other USAF and commercial applications include optical communications, heterodyne detection, and high resolution spectroscopy.

AF93-081 TITLE: Thick Aberrator Compensation in Postdetection Image Correction

CATEGORY: Basic Research

OBJECTIVE: Develop method of imaging through thick turbulence using multiple reference beacons and post-detection processing.

DESCRIPTION: Initially, effort will be directed towards research on imaging through thick turbulence when measurements of the turbulence at different points in the aberrator are known. Space object identification from the ground, weapons systems which need to sight and discriminate targets along horizontal paths through the atmosphere, and airborne imaging platforms all require high resolution images through thick aberrators. In anticipation of the requirements of this new generation of smart weapons and imaging systems, this contract will investigate high performance methods of solving the turbulence degradation problem based on partial knowledge of the aberrating media. The research will concentrate on how well techniques for compensation will work, methods for placing references throughout the aberrator, and the performance dependence on the number and type of measurements. The basic method of post-detection correction will be the baseline for the work, with analysis and computer simulations as the method of demonstrating system performance.

Phase II: Proposed new beacon geometries and methods, radiometry, and noise characterization will be the principle focus of the system application portion of the work. Augmentation of the analyses from Phase I, with attention to questions which arose in Phase I, will the be first task. A laboratory or field experiment for the final concept will be designed and executed. It should demonstrate both concept feasibility and predicted performance in agreement with Phase I and Phase II analysis and simulations. Phase III may provide a prototype system transitioned to the Phillips Laboratory for airborne or weapons systems proof of concept.

AF93-082 TITLE: Electrically Tuned Multi-Element Fabry-Perot Spectral Filter

CATEGORY: Basic Research

OBJECTIVE: Develop a monolithic electronically tunable multi-element spectral filter for spectral imaging and automated target recognition (ATR) applications.

DESCRIPTION: Multispectral imaging applications require an imaging spectrometer. This can typically be accomplished using a scanning spectrometer in conjunction with a conventional imaging system. Instead a tunable Fabry-Perot filter may be placed in front of a detector array. This design can offer a compact non-inertial system design. Single element liquid crystal Fabry-Perot filters have been produced for this task. We require a multi-element spectral filter for more sophisticated spectral imaging applications. Such a multi-element filter would afford parallel processing capabilities in image processing applications. This filter would afford parallel processing capabilities in image processing applications. This multi-element filter may be based on liquid crystal or semiconductor technologies. A liquid crystal or quantum-well based phase shifter can be sandwiched between two broadband highly-reflective coating stacks to construct this filter. A device which has an operational spectral bandwidth of at least 20% of its center frequency is required. The device should operate in the visible to near IR wavelengths. A Finesse of 50 is required to afford adequate spectral resolution. The optical thickness of the Fabry-Perot cavity should be no more than 20 waves at grand center in order to afford adequate rejection of other in-band frequencies. A throughput at line center of at least 30% is necessary for a successful candidate. The device should have an extinction ratio of over 100: 1. Actuation speeds of 20 Hz or more are desired.

Phase I: This phase will consist of the manufacture of a one-dimensional device consisting of at least 50 rectangular shaped elements. The aspect ratio of these elements shall be at least 100:1 (length to width). The total active area of the multi-element device should be approximately 1 in 2. A successful candidate will address the insertion loss, temporal and spectral bandwidth, Finesse, optical quality, and extinction-ratio issues. The device should operate between 0.5-1.5 microns wavelengths.

Phase II: Phase II will consist of extending this device technology for production of two-dimensional devices. These devices will consist of two dimensional arrays of individually programmable spectral filter pixels for the purpose of multi-spectral image processing.

AF93-083 TITLE: Data Processing Routines for Adaptive Optics Systems

CATEGORY: Basic Research

OBJECTIVE: Develop data processing system based on Fourier Transform theory for multiple input/output electrical and optical hardware measurement calculations.

DESCRIPTION: Adaptive optical systems being tested by the Phillips Laboratory are multiple input/multiple output (MIMO) control systems that can consist of over 100 channels of highly coupled controlled actuators and wavefront sensors. At the present time there is no available software to support processing the data from these MIMO hardware systems. Approaches such as Singular Value Analysis and Eigen value analysis are presently being developed by control theorists to evaluate MIMO system performance. Optical characterization techniques that use Zern like polynomial decompositions have been used for many years to characterize optical system performance. Fourier Transform techniques are widely used to evaluate single input/single output and multiple input/single output control systems. A logical and needed effort is to design and develop software that can process hardware data to evaluate MIMO system performance. One function of this software might be to decompose sets of measured data into singular value modes and then calculate magnitude and phase versus frequency functions for the modes based on the gathered test data. Another useful function of such a program might be a transformation between singular value modes and Zern like polynomials. This would permit comparing electrical errors measured with the control loop to optical errors measured with interferometer instruments. Other useful analyses functions would be Strehl ratio plot computed from control system errors, and rms phase error calculations. It would be beneficial if the software could run on a PC such as a 486.

Phase I: The software package architecture design would be the Phase I objective. The successful small business would need to understand both optical system characterizations and MIMO control systems, in order to plan & design the software package.

Phase II: Phase II would require the coding and demonstration of the software package. Initial demonstrations of the processing routines would be expected to be run by the contractor using data from adaptive optics simulations provided by the contractor. If the package was successful the Phillips Laboratory would provide measured data from adaptive optics hardware for the final level of package checkout. Phase III of the effort would be to develop a commercial package that could be sold to customers around the world. The fields of astronomy, imaging, and large space structures would be interested in such a data processing package. The contractor might want to interface to an existing commercial package such as Matrix X, Control C, or MATLAB and make this package a "toolbox" that would be marketed with the existing software.

AF93-084 TITLE: Optical Parametric Oscillator (OPO) with a Diode Laser Pump Source

CATEGORY: Basic Research

OBJECTIVE: Develop and demonstrate a tunable OPO using a diode laser as the pumping source.

DESCRIPTION: Recent developments in semiconductor laser diode technology have taken the power output of these devices from the milliwatt into the watt regime. At these power levels, many USAF applications, such as infrared countermeasures (IRCM) and optical communications exist for such a compact, robust source. These applications, however, require sources which are wavelength tunable or, at least, operate at a non-absorbing wavelength in the atmosphere. The current semiconductor materials suitable for high-power diode lasers do not contain bandgaps which allow this. A solution to this problem is to use an Optical Parametric Oscillator (OPO) with the diode laser as the pumping source. The output of this device would be tunable through either temperature- or incident angle-control of the nonlinear crystal. Although OPO's have been demonstrated with several other laser sources, none have been demonstrated with diode lasers. Reasons for this are: (1) High intensities (MW/cm2 range) are required for the nonlinear process of the OPO to occur. The output power of a single laser diode is typically in the MW range; (2) Since the OPO requirements cannot be met with single devices, diode arrays must be used. OPO's also require a clear, nearly diffraction-limited beam over the nonlinear interaction length. The output of such arrays only approaches the diffraction limit when coherence of the entire array is achieved; (3) The beam must be focused to a very small spot to achieve the required OPO intensity level. Focusing the beam this tightly shortens it's Rayleigh Range and, therefore, the effective interaction length. This impacts the overall gain of the OPO since it is a function of the intensity-length product. However, possibilities exist to develop an OPO in nonlinear fibers and waveguides, both of which presently exist.

Phase I: Phase I of this program is to design an OPO which is driven by a diode laser source. The nonlinear crystal requirements to be used per diode type (i.e., 0.7-0.9-micron AlGaAs or 1.2-1.6-micron InGaAsP) will be determined. Examples of such requirements are the transparency wavelength range and the phase-matching wavelength range. Once these parameters have been determined, the appropriate nonlinear materials will be researched, and the proper material or set of material will be determined. Also included in Phase I will be the design of the OPO cavity and any required optics.

Phase II: Phase II should apply the design of Phase I and physically develop an OPO driven by a laser diode source. The development is to include quantification of such figures of merit for an OPO as intensity threshold of the nonlinear process, gain of the device, conversion efficiency from the source wavelength to the desired wavelength, and temperature- and/or angle-tuning parameters of the device. Such an OPO device will be deliverable at the end of the Phase II period. The technology developed has direct impact on the critical Air Force problems of Strategic Relocatable Targets, Secure Optical Communications, and Optoelectronic Warfare. Other USAF and commercial applications of this technology include optical communications, heterodyne detection, and high-resolution molecular spectroscopy.

AF93-085 TITLE: Solid State Laser Pumped 3-5 Micron Lasers

CATEGORY Basic Research

OBJECTIVE: Develop an efficient compact 3-5 micron laser optically pumped by an existing solid-state laser.

DESCRIPTION: An ideal laser technology for applications to tactical airborne countermeasures would provide both access to the 3-5 micron spectral region in the near term and later growth to the 8-12 micron band. An appropriate technology must also meet many performance requirements such as pulse energy, repetition rate, size, weight, and reliability. There is currently no clear choice for a fully satisfactory device technology for this application. It is anticipated that the eventual solution will be solid-state lasers pumped with diode laser arrays and perhaps frequency shifted by means of nonlinear optical phenomena, it is not clear that even in the long term NLO techniques will be sufficiently rugged to survive the military environment. However, the compactness, low weight, and higher efficiencies associated with solid-state lasers will make these devices leading contenders for military applications for years to come. One approach to the 3-5 and 8-12 micron applications are laser-pumped m atoms as a source of infrared laser light. This technique has been shown to be useful for generating laser radiation in spectral regions from the visible through the far-infrared. Numerous laser lines in the mid-infrared have been pro ing standard lasers to pump common molecules in the gas phase such as CO2, HcO, and NH3. The wavelength ran de-pumped solid-state lasers can be ex to the 3-5 micron region by using them to pump appropriate molecula g r standard lasers and optical wavelengt ion techniques could be used as well, but size, weight, and efficiency n e considered.

ase I: The goal of this effort is to determine if a solid-state laser pumped laser is a viable concept for airborne tactical

applications both in terms of size, efficiency, and wavelength selectivity. Then, if feasible, a brass board prototype will be built and demonstrated. The end product of Phase I will be a technical report on the methods/techniques to generate a 3-5 micron laser pumped laser (pulsed or DW).

Phase II: The end product of Phase II will be a detailed design, fabrication and experimental testing of the 3-5 micron laser.

AF93-086 TITLE: Efficient Cooling of Semiconductor Laser Arrays

CATEGORY: Basic Research

OBJECTIVE: Develop and demonstrate an efficient thermal cooler for high-power diode laser arrays.

DESCRIPTION: Semiconductor laser diode arrays are currently being developed which have output powers in the tens-of-Watts regime, which are increasing at a steady rate. These arrays cover areas on the order of 1 square cm, and the heat dissipation requirements are a major concern in implementation of these devices. The design and demonstration of an efficient semiconductor laser array cooler (SLAC)is sought with the following requirements. (1) The SLAC shall have an areal cooling capacity of 1000 W/sq. cm over a minimum area of 1 sq. cm, and a linear capacity of 100 W/cm for laser diode bars. (2) The thermal tolerance must be +/- 1 K for an operating temperature of 300K. (3) The SLAC must operate over a range from 250K to 350K. (4) The design shall be self-contained, compact and cost-effective to produce. (5) The design shall be capable of operating in zero-g loads for space applications, as well as high-g loads found in tactical operations.

Phase I: Phase I shall be the selection of a technology that fulfills the requirements listed above, and design a SLAC using the technology to meet those requirements. Exploration of new and innovative cooling techniques is encouraged. Micro-heat pipes and Micro-channel coolers are possible solutions to the problem, while other novel technologies will also considered. Once the SLAC design is reached, all fabrication requirements necessary for implementation of the device shall be addressed.

Phase II: Phase II of this program is the implementation of the Phase I design. The implementation shall include the fabrication, test and evaluation of the SLAC device. The test results and a working device will be deliverable upon completion of this phase. Phase III will be the transfer of the program technology to a mission-oriented user for supplying SLAC's, as well as a transfer to, or production for the private sector. The technology developed has direct impact on the critical USAF problems of Strategic Relocatable Targets, Secure Optical Communications, and Optoelectronic Warfare. Other USAF and commercial applications of this technology include optical communications, heterodyne detection, and high-resolution molecular spectroscopy.

AF93-087 TITLE: Instrumentation for Aero-Optical Research

CATEGORY: Basic Research

OBJECTIVE: Develop real-time instrumentation for determining the optical wave-front properties of flows around aerodynamic systems.

DESCRIPTION: The Phase I effort will consist of research in various ways of determining the wave-front distortions, on a continuous, real-time, and temporal basis, generated by turbulent flows on an unaberrated (e.g., planar phase) light beam. There exist methods, such as Holography and Interferometry, which directly measure phase, but they provide only a "snap-shot" view, or are slow enough relative to flow time-scales so as to inaccurately reflect the temporal characteristics of the flow. Past research in turbulent flow has revealed a great deal of temporal and spatial structure; progress in the understanding and design of aero-optical systems depends on accurately determining the effect of the flow structure on light transmission. Thus, the characteristics of aero-optical instrumentation must match those of the aerodynamic flow-field. Flows of immediate USAF interest involve convective velocities of up to 300m/s ans spatial scales down to 0.01m. Thus, the instrumentation must be capable of sampling, without aliasing effects, events with time-scales on the order of 30 microseconds. The instrumentation must be compatible with wind-tunnel experiments and must provide digitized data for computerized post-processing and analysis. The end results are the spatial and temporal characteristics of the flow-field. These can include, but are not necessarily limited to, spatial correlations, phase-maps, jitter, and bore-site error. The system must be capable of being integrated with fluid mechanical diagnostic instrumentation (e.g., cold or hot-wire probes) so a direct link of high temporal resolution may be made between the fluid mechanics and the resulting optics. Beam diameters, scaled by the flow-field dimension (z) range from z/10 to 10z, and the electromagnetic spectrum ranges from visible to IR.

Phase I: This Phase will, at a minimum, include research towards the selection of the best candidate method for

determining optical wave-front properties of flows around aerodynamic systems and the preliminary instrumentation designs.

Phase II: Phase II will be the demonstration of the system on high-subsonic flow about a cylinder, with and without a trailing edge splitter plate. Phase III would provide a follow-on system for transition to wind-tunnels for use by program offices, laboratories, and other organizations such as NASA. This topic is important because of the renewed emphasis that aero-optics is receiving in Air Force Research and Development. This emphasis stems from such applications as imaging through flight vehicle flow-fields (as in Long Range Oblique Photography) and the projection of laser beams for both active imaging and target destruction (as in Theater Missile Defense). Improved aero-optical instrumentation capable of rapidly measuring wave-front distortions and determining spatial and temporal scales is critical, first to the adequate understanding of the light transmission problem and then to the development and design of future systems which are subject to aero-optical effects.

AF93-088 TITLE: USAF - Phillips Laboratory; Technology Transfer

CATEGORY: Advanced Development

OBJECTIVE: Assess DOD and commercial applications, determine required refinements and build prototype based on immature technologies originating at the Phillips Laboratory.

DESCRIPTION: The Phillips Laboratory (PL) is the premier DOD organization conducting R&D in military space, missiles, directed energy, and geophysics technology. Ongoing or previous R&D efforts at or on behalf of the PL often result in specific state-of-the-art technological innovations which, due to USAF priorities, are not developed to maturity. Many of these technologies, if properly developed and refined, may offer truly innovative solutions to a great many DOD and commercial requirements. The following subtopics describe specific immature technologies with potential military and commercial applications. Contractors may contact the Defense Technical Information Center (DTIC) for technical information packages which support these subtopics. This topic and the specific subtopic must be identified by topic number and title on all related requests submitted to DTIC and on contract proposals submitted to the PL.

Phase I: An in-depth assessment of potential commercial and military applications will be required. As a result of this assessment, determine and design the initial necessary refinements.

Phase II: Based on the original PL immature technology, the commercial/military applications assessment, and the design refinements, build or fabricate, test and validate a laboratory demonstration model or prototype.

A. ADVANCED FIBER COUPLED SEMICONDUCTOR LASERS; HIGH POWER DEVICES: Numerous applications including illumination, countermeasures, friend or foe identification, medicine, and materials processing can be significantly improved by using high power laser arrays with fiber optic output couplers. Devices capable of delivering 50-100W in 800 -900nm at the fiber output are required. The Phillips Laboratory (PL) has developed unique expertise in the field of "diode lasers" and that expertise will be placed at the contractor's disposal. The Phase I technical effort should concentrate on developing designs to reach high powers in compact packages, with a proof of concept demonstrator, at the 10W level, delivered upon completion. In Phase II a 50-100W demonstrator shall be developed and delivered for field evaluations.

B. ADVANCED FIBER COUPLED SEMICONDUCTOR LASERS; ALTERNATE WAVELENGTH DEVICES: Numerous applications including illumination, countermeasures, friend or foe identification, and materials processing, can be significantly improved by using advanced sources providing visible and min-infrared light from fiber optic coupled semiconductor lasers. The Phillips Laboratory has developed unique expertise in the field of "diode Lasers" and that expertise will be placed at the contractor's disposal. Phase I technical efforts should include developing designs for visible, blue-red, laser arrays providing 10W fiber output and mid - infrared 2-5 micron laser arrays providing 10W fiber output. The proof of concept demonstrator at1-2W/2Microns will be delivered. Phase II should develop and deliver a 10W, 670nm red demonstrator and a 10W, 2 Micron infrared demonstrator4for field tests.

C. PASSIVE WIDEBAND ELECTROMAGNETIC FIELD SENSORS: There is an interest in devising RF sensors, for use in low power microwave (LPM), high power microwave (HPM), and ultrawideband (UWB) applications, that will perform at higher frequencies and wider bandwidths (at least 10GHz)than what are currently available. Alternatives, to the traditional multi-gap and asymptotic conical dipole geometries for detecting and monitoring continuous-wave and transient electromagnetic phenomena, are desired. In addition, schemes employing direct modulation of diode lasers are not desirable because of their bandwidth and dependence on embedded microwave circuitry at the sensor. Ideally, the sensors will be physically small and will be fabricated/assembled from materials that will minimally perturb the fields to be measured. The transmitter, data link, and receiver should have minimal insertion loss. Presently, efforts are underway to explore and develop sensor alternatives to the technologies mentioned above. Pending the results of current in-house research, manufacturing and fabrication techniques29 and methodologies will need to be identified and implemented. The prototype envisioned will most likely incorporate various optoelectronic and related technologies. Modifications may be made to sensing schemes with regard to packaging considerations.

However, an emphasis on novel configurations employing LiTaO3 or LiNbO3 should be given serious consideration. It is also expected that performance characteristics will be maintained. Typical bandwidths will exceed those mentioned above with dynamic ranges of at least three decades or more. Typical power densities might be micro W/sq. cm to mW/sq. cm for LPM and tens of W/sq. cm to several kW/sq. cm for HPM. Low power microwave, high power microwave, and ultrawideband testing must be performed on sensors in various stages of development or packaging. Laboratory facilities, with these capabilities, can be made available subject to negotiations.

AF93-089 TITLE: Workstation Based Interactive Space Sensor Systems Simulation Package

CATEGORY: Basic Research

OBJECTIVE: Develop and deliver an easy to use simulation package for rapid concept exploration which includes both orbit and utility analysis.

DESCRIPTION: Many different simulation packages currently exist on sensors, orbit analyses, and systems analyses. However, an integrated simulation more than often requires large amounts of overhead support. This support includes items such as data file preparation, data entry and verification, large run times on large systems, interpretation of results, and feeding of interpreted results to a different system for display. Thus, it takes weeks of work and a significant amount of manpower just to run one simulation. As a result, both time and costs of such systems make them impractical for rapid concept exploration use. Moreover, data interfaces probably do not support easy information exchange. In rapid concept exploration situations, a user must be able to perform rough order system level trades quickly and pass on the results to the interested community by way of a working model. Consequently, a stand-alone and easy to use simulation package with the following characteristics can provide an extremely useful tool in the area of rapid concept exploration.
Characteristics:
1. User can interactively run many simulations with the ability to vary the parameters without any overhead support.
2. Combines orbit analysis, sensor performance estimation, and utility analysis.
3. Provides immediate display and hard copy of usable outputs.
4. Supports easy and standardized information exchange.

Phase I: Efforts in Phase I shall include defining, in detail, the capabilities of this simulation package. The definition must include developing performance specifications, setting data interface standards, collecting models, identifying possible available software for modification/integration, and propose the target platform.

Phase II: The second phase efforts shall produce the actual package with associated documentation. Also required will be the initial user training and training materials.

AF93-090 TITLE: Methane Arcjet

CATEGORY: Basic Research

OBJECTIVE: Determine the magnitude of the sooting problem in methane arcjets.

DESCRIPTION: Chemically powered orbit transfer vehicles can deliver only 40 percent of the initial low earth orbit mass to geosynchronous orbits. Electric rocket engines can double the mass delivered to geosynchronous orbits. Electric rocket engines can double the mass delivered to geosynchronous orbit. These high performance engines use one-half to one-third the propellant of chemical engines and this reduction in propellant mass enables a corresponding increase in payload. The most technically mature electric rocket is the low- impedance ammonia arcjet . However, its performance is limited to a maximum specific impulse of 820 seconds and an efficiency of 35 percent. This project will examine the potential of using methane as an arcjet propellant instead of ammonia. Methane holds great promise as a propellant because it has the same store ability properties which make ammonia attractive with a high thruster performance potential close to hydrogen without the storage problems associated with hydrogen.

Phase I: This SBIR will determine if there are any sooting problems associated with the use of methane and to provide innovative techniques to eliminate the sooting caused when the arcjet uses methane as a propellant. Suggested techniques for determining if sooting is a problem are using an arcjet adapted to use methane or using a simplified electrode configuration which simulates an arcjet. Proposals are not limited to these suggested approaches, but will be required to prove that any proposed approach accurately simulates an arcjet's operating conditions. The reference arcjet for this evaluation shall be the

26-kilowatt ammonia thruster developed by the USAF's Phillips Laboratory.

Phase II: This will fabricate and test a thruster on a thrust stand to verify methane performance and lifetime.

Phase III: It will concentrate on commercially developing the methane arcjet for use as primary or secondary propulsion on commercial satellites. Proposals will be judged on understanding the problem, demonstrated expertise in the field, and innovative approaches.

AF93-091 TITLE: Novel Synthesis of Cubane Precursor

CATEGORY: Basic Research

OBJECTIVE: Develop a Novel, Low Cost Synthesis for Cubane Dicarboxylic Acid.

DESCRIPTION: The chemical compound cubane (C8H8) and its derivatives methyl cubane and dimethyl cubane are of interest as additives to or replacements for the kerosene-based rocket propellant RP-1. Cubane and its derivatives are synthesized from cubane dicarboxylic acid. However, the best reported syntheses of cubane dicarboxylic acid involve seven or eight chemical reactions, many of which are difficult to scale up, expensive, or relatively low yielding. A totally new synthetic route to these cubane derivatives is needed. It is desirable that the new process involve less than four steps, starting within expensive, readily available materials. Further, it is desirable that the synthesis require limited workup and purification between steps.

Phase I: This effort should be directed at identifying alternative synthetic pathways and techniques.

Phase II: This will emphasize production of 10-100 g lots in the laboratory using less than one man month of effort; a production cost analysis will also be performed.

Phase III: This effort will focus on commercial applications of adapting cubane and its derivatives as rocket fuels or fuel additives.

AF93-092 TITLE: Prototype Storage and Delivery Device for Cryogenic Solid Hydrogen Propellants

CATEGORY: Basic Research

OBJECTIVE: Develop a Cryogenic container capable of storing and delivering cryogenic hydrogen solids into a combustion chamber.

DESCRIPTION: Cryogenic solid propellants may provide revolutionary advances in rocket propulsion. Solid hydrogen and mixtures of energetic atoms or molecules with solid hydrogen are relatively difficult to form and store for long periods of time. Innovative approaches to the storage and transfer of these cryogenic solids are needed. If these cryogenic hydrogen based fuels are to be useful for rocket propulsion, a storage and delivery device needs to be developed that will have the following characteristics: a) Must be capable of condensing gaseous hydrogen directly into the solid state at a temperature less than 10K(-263 degrees C), b) The cryogenic solid must have a usable lifetime of at least one hour, c) The container must store at least one gram of cryogenic solid, d) Optical inspection windows shall be included to determine the content of the storage container, e) Some method of delivering cryogenic material into a combustion chamber must be developed and included in the storage of the container, f) Avoidance of the liquid state is required in the transfer method, especially when energetic atoms or molecules are a component of the cryogenic solid mixture, and g) The flow rate into the combustion region must be controllable. The pressure of the transferred material must be greater than atmospheric pressure and ultimately must be compatible with the rocket combustion chamber.

Phase I: The results of this Phase I effort must include a detailed practical design.

Phase II: This effort will also include a detailed practical design to be built in this Phase II.

Phase III: These efforts will focus on the development and testing of larger scale propulsion systems based on the Phase II results, with subsequent transition of this technology to the industrial propulsion community.

AF93-093 TITLE: Critical Technology Demonstration for Pulsed Plasma Propulsion

CATEGORY: Basic Research

OBJECTIVE: Demonstrate the scale ability and performance of a megajoule class Magneto plasma dynamic (MPD) plasma

thruster.

DESCRIPTION: The extension of small anode centered, MPD plasma thrusters to useful energy levels above 1 megajoule has been limited because of unforeseen adverse operational characteristics such as parasitic currents. Below 500 kilojoules, scaling and system operation give predictable performance. Thus, a gap exists between the desired operating regime and the experimental limit. Continued work by a number of researchers over the last five years has led to a better understanding of the arc physics, and a number of promising solutions to the parasitic current problem, such as field distortion elements (FDE's), have been successfully tested at low energy. Therefore, it is desirable to test a thruster in the 1 to 10 megajoule regime to extend the scaling laws and verify that the operational difficulties have been corrected.

Phase I: This should be a limited effort consisting of facility definition and preparation, diagnostic development, and testing of a scaleable 100 to 500 kilojoule MPD plasma device in order to provide confidence in the approach proposed for Phase II.

Phase II: It consists of the development, modeling, and demonstration of a full scale, megajoule plasma device. Proposals will be judged upon insight and understanding of the problems, demonstrated expertise in relevant fields, qualifications of the proposed team, facilities, strength and logic of the proposed program, organizational structure and management approach, and overall quality of the proposal.

Phase III: It should open the door to many applications, such as compact, high performance space propulsion and power devices for the Air Force's mission in space; and neutron radiographic imaging, high-resolution x-ray lithography, and production of short life isotopes for medical application for commercial ventures.

AF93-094 TITLE: Advanced Electric Propulsion Insulators

CATEGORY: Basic Research

OBJECTIVE: Develop New Insulator Materials for Use in Electric Propulsion Thrusters.

DESCRIPTION: Chemically powered orbit transfer vehicles can deliver only 40 percent of the initial low earth orbit mass to geosynchronous orbits. Electric rocket engines can double the mass delivered to geosynchronous orbit. These high performance engines use one-half to one-third the propellant of chemical engines and this reduction in propellant mass enables a corresponding increase in payload. Critical to achieving operational status for these thrusters is the development of ultra-high temperature insulators from which thrusters can be fabricated. The goal of this SBIR is to develop materials with continuous operating temperatures of not less than 3000 degrees centigrade, good machinability, durability, high thermal conductivity, and high electrical resistance.

Phase I: It will identify and evaluate available and new materials.

Phase II: It will focus on obtaining and testing the most promising candidates in operational thrusters.

Phase III: It will concentrate on the commercial development of these insulators for applications such as in electric thrusters or high power switches. Proposals will be judged on understanding the problem, demonstrated expertise in the field, and innovative approaches.

AF93-095 TITLE: Treatment of Nitrate and Mixed Nitrate/Sulfate Contaminated Waste Water

CATEGORY: Basic Research

OBJECTIVE: Develop a process to treat waters containing high concentration of nitrates and mixed nitrate/sulfate to enable reuse of the waste water or, as a minimum, permit dumping to grade.

DESCRIPTION: A Second Stage nitrogen tetroxide vapor scrubber system is currently in pilot stage of development and is anticipated to be in the field in early 1993. This system, which is designed for use in series with the current sodium hydroxide/water vapor scrubbers currently installed at both East and West coast space launch facilities, uses a blend of sodium hydroxide and sodium sulfite in water as the scrubbing liquor. Significant quantities of waste waters containing high concentrations of nitrates and mixtures of nitrates and sulfates, which currently must be shipped off base for treatment and/or disposal, will be produced by these devices during propellant servicing of the launch vehicles and payloads. The Stage I scrubber has about a 2500 gallon capacity; Stage II will be about 300 gallons. An effective and economical process to treat these waste waters on site is needed to permit recovery and reuse of the water or safe release to the environment. The waste waters would contain a mixture of sodium hydroxide, nitrate and nitrite in the case of the Stage I scrubber, and sodium hydroxide,

nitrates, nitrites, sulfite, sulfate, and other sulfur containing compounds in the case of the Stage II scrubber.

Phase I: This consists of developing the required chemistry and processes for neutralizing and detoxifying the waste waters (e.g., chemical, catalytic and biological processes are potential approaches)and preliminary design of the associated process hardware. Laboratory research using actual samples of waste waters would be conducted to characterize the process parameters and develop design criteria for the Phase II Pilot Scale process demonstration.

Phase II: This would consist of the design, fabrication and demonstration testing of a pilot scale process developed in Phase I. This testing would be designed to further characterize the process and to develop scaling criteria and process control criteria. Testing would successfully demonstrate the efficiency of the process using a variety of actual wastes and would provide the basis for economic assessment of the process.

Phase III: This would demonstrate the process operation in prototype, full scale hardware, interfaced with a selected on-site operation.

AF93-096 TITLE: High Emissivity Surface Treatments for Arcjet Thrusters

CATEGORY: Basic Research

OBJECTIVE: Develop long-life surface treatments for arcjet thrusters.

DESCRIPTION: Chemically powered orbit transfer vehicles can deliver only 40% of the initial low earth orbit mass to geosynchronous orbits. Electric rocket engines can double the mass delivered to geosynchronous orbit. These high performance engines which use one half to one third the propellant mass enable a corresponding increase in payload. The most technically mature electric rocket is the low impedance ammonia arcjet. However, its performance is limited to a maximum specific impulse of 820 seconds and an efficiency of 35%. This project will develop and test new techniques and/or materials to increase the emissivity of the tungsten anode of an arcjet enabling it to operate at higher power levels with improved performance.

Phase I: It will determine which techniques and materials offer the greatest emissivity at the operating temperature of a 26-kilowatt ammonia arcjet's anode and will test the most promising concept or concepts. Suggested concepts are deep threading of the outer surface of the anode, high emissivity coatings, or a combination of both. Proposals are not limited to these suggestions. The use of an arcjet is no required for Phase I, but the proposer must verify that the arcjet simulator produces the same conditions experienced by a 26 kilowatt low-impedance ammonia arcjet.

Phase II: This will involve the construction of an arcjet using the most advantageous surface treatment and testing the thruster on a thrust stand to verify its performance and determine its life time.

Phase III: It will concentrate on commercially developing this technique for possible use on high temperature space radiators. Proposals will be judged on understanding of the problem, demonstrated expertise in the field, and innovative approaches.

AF93-097 TITLE: Infrared all Sky Imager

CATEGORY: Basic Research

OBJECTIVE: Develop an infrared all sky imaging system to measure cloud spatial, temporal, microphysical, and optical properties.

DESCRIPTION: The design of a novel infrared all sky imaging system for the detection and determination of cloud spatial, temporal, microphysical, and optical properties is solicited. Clouds in either the foreground, that is between the sensor and the target, or in the background, behind the target, can limit the effectiveness or even render inoperable Air Force (AF) systems. Clouds are frequently sited as one of the DOD areas requiring a significant amount of new research. To truly understand how clouds affect AF Electro-Optical (EO)systems, it is necessary to fully understand cloud radiative properties and their radiative interactions with the surrounding environment. This understanding will only be obtained when we can fully describe the cloud spatial, temporal, microphysical, and optical properties. The use of infrared focal plane array technology to develop a day and night time all sky imaging capability should be considered. The infrared imaging system is not restricted to the long wavelength infrared atmospheric window spectral region. The possibility of using specific infrared spectral band information in either of the two broad band atmospheric windows to obtain cloud microphysical and optical properties should be considered.

Phase I: Phase I of this SBIR effort should investigate the feasibility of developing an automated all sky infrared imaging system and the feasibility of using infrared all sky imagery to obtain cloud microphysical, optical and/or radiative properties.

Phase II: Dependent upon and based on the Phase I results, a prototype all sky infrared imaging system will be fabricated and the algorithms to analyze the infrared imagery to obtain the desired cloud properties will be developed and delivered to the Air Force in Phase II. This phase should also include a short duration data collection period and the subsequent data analysis to evaluate the imager performance.

Phase III: Again, based on the result of the first 2phases, a relatively inexpensive automated operational all sky infrared imaging system, to include a data logging and data analysis capability, will be developed. The algorithms used to analyze the imagery should be fully validated during Phase III.

AF93-098 TITLE: Multipath Correction for Global Positioning System Satellite Range Measurements

CATEGORY: Basic Research

OBJECTIVE: Develop new approaches to real-time multipath correction for Global Positioning System ionospheric and satellite range measurements.

DESCRIPTION: New and creative approaches are solicited for real-time correction of multipath errors in Global Positioning System (GPS) ionospheric and satellite range measurements from stationary dual-frequency precise-code GPS receiver systems. Multipath(reflections) from objects near the receiver antenna can cause substantial errors in the receiver's measurement of ionospheric total electron content and satellite range. The multipath errors can exceed the ionospheric errors which the second GPS frequency was incorporated to correct in satellite range measurements. Such multipath errors can have a detrimental effect on GPS precise positioning, ionospheric measurements, surveying, and other applications. GPS multipath is particularly insidious, in that it will degrade system performance while giving little indication of the source of the problem without use of specialized tests. What is desired is a system approach that will automatically correct for multipath to a level of accuracy and antenna coverage much greater than existing approaches, without requiring any specialized knowledge on the part of the operator. Application of such an approach in ionospheric measurements, for example, could extend low elevation capability from 15 degrees nearly to the horizon - nearly doubling the geographic coverage, allow regular use of inexpensive antennas, and greatly simplify siting requirements. Such an improvement would be a significant benefit to the Air Force effort to use GPS technology to measure ionospheric range errors for making corrections to space surveillance and early warning radars. An example of acceptable performance would be a technique that within a short time of GPS receiver installation, for example 3 days, would automatically acquire knowledge of the local multipath and would then correct multipath in real-time for all subsequent data. One present technique, limiting antenna sensitivity at lower elevation angles, is effective at reducing the strength of many multipath signals - but at the expense of unacceptably reducing the receiver's spatial coverage (by one third or more). Other techniques that combine average differential carrier phase and differential group delay to reduce multipath in ionospheric electron content measurements typically provide good correction only when a long period (more than 1 hour) of data is averaged. Such an approach cannot be effective for the half of the low-elevation coverage where the satellite is rising.

Phase I: Efforts in Phase I should result in the development of the proof-of-concept of the approach.

Phase II: In Phase II the contractor shall design an engineering model system and demonstrate the concept. Potential exists to incorporate innovative approaches in GPS receiver firmware, or in an adjunct PC/notebook computer that could be transparent to users of GPS receiver's data output. Therefore, particular attention will be given to straightforward or simple-but-elegant approaches that are more readily implemented in such technology.

AF93-099 TITLE: Ion Composition Detection in High Temperature Plasmas

CATEGORY: Basic Research

OBJECTIVE: Develop new innovative approaches for measuring positive and/or negative ion concentrations in high temperature, dense and/or tenuous plasmas of atmospheric origin.

DESCRIPTION: An important focus of current research in the USAF is the effect of high temperature plasmas on the environment and operation of USAF systems and space vehicles. Sheath and wake plasmas associated with re-entry and hypersonic vehicles, jet engine exhaust, and rocket plumes both in the atmosphere and in space are examples of high temperature plasmas that can interfere with radio wave propagation (e.g., communications blackout) and can significantly alter the detectability of the vehicle (e.g., radar cross sections). The properties of these plasmas, in particular the electron density, are typically calculated with chemical kinetics computer codes that are based on kinetic data taken at laboratory temperatures lower

than the plasma temperature. Ion composition data from the actual high temperature plasmas are essential as a benchmark for the validation of the code predictions and for development of alleviative measures. Proposals for innovative techniques for sampling the ion composition of these high temperature plasmas are solicited. A list of design goals for an instrument or technique is given below. To insure overlap with existing research efforts , proposals for small, quadruple type mass spectrometers that could easily be adapted to a variety of environments (ground-based tests of flames, plasma arcs, jet and rocket engines, and space-based tests on sounding rockets, satellites and the space shuttle) are particularly encouraged. Proposed techniques need not be limited to quadruple mass spectrometry. The design and construction of an instrument to sample ion composition in the severe environments outlined in the "design goals list" obviously involves solutions to many challenging technical and scientific problems, including miniaturization of the mass spectrometer or other diagnostic, heat shielding, differential pumping, ion transport and reactions through shock waves, debye sheaths or pressure/temperature/plasma density gradients, calibration, and so on. Since solution of all of these problems may be beyond the scope of the current solicitation, proposals which address one or more of the issues, but do not reach the point of providing a completed instrument, are welcome.
DESIGN GOALS: Ion Composition Measurements in High Temperature Plasmas NOTE; proposed instruments do not have to meet the full dynamic range listed for all conditions. Instruments or techniques which address aspects of the ion sampling problem but not the entire problem are welcome.
Type of Data Required: Total number density of positive and/or negative ions, identity of individual ion species and their concentrations.

Mass Range of Ions:	1-200 atomic mass units (amu)
Mass Resolution:	Single mass resolution across mass range.
Temporal Resolution:	one full mass spectrum per second.
Ion Density Range:	1E5 to 1E13 ions cc.
Neutral Gas Pressure Range:	atmospheric pressure to high vacuum.
Neutral Gas Temperature Range:	300 - 2500K.
Neutral Gas Flow Velocity:	0 - Mach 5.
Instrument Size*:	4" dia by 12" long.
Instrument Weight*:	5 lbs.
Measurement Accuracy	+/- 30% for major ions, and+/- factor of 3 for minor ions.

*excluding vacuum housing, heat shields, etc.

Phase I: Conduct and complete instrumentation design efforts.

Phase II: Construct, test and deliver instrumentation for use in plasma sampling experiments.

AF93-100 TITLE: Numerical Weather Prediction Modelling via Massively Parallel Computing

CATEGORY: Basic Research

OBJECTIVE: Develop computational structures and algorithms for limited area, grid point models to exploit the efficiencies of highly granular multi-processors.

DESCRIPTION: Evolving military concepts of operations in the wake of the Desert Storm experience and the substantial restructuring and downsizing of force structure due to the end of the Cold War are markedly changing the needs for, and the nature of, operational weather support in the USAF. The need to develop a Tactical Forecast System (TFS) to support contingencies that could occur through the concept of Global Reach - Global Power is a priority for the USAF R&D community. Tomorrow's TFS will be driven, in large measure, by a mesoscale (limited area) numerical weather prediction model(s) (NWP) embedded in a computer architecture compatible with the need for compactness and transportability in battlefield scenarios. Finely grained multi-processing computer systems (with up to several thousand individual processing units linked together) offer the potential of satisfying TFS needs. However, there has not been, to date, a robust performance demonstration of representative mesoscale NWP grid point models in a massively parallel computing environment using, for example, conventual shared-memory algorithms on a standard operating system such as UNIX. The approach for such a task should exploit the local connectivity nature of grid-point models to minimize the search of a small data set in a large data base.

Phase I: During the Phase I effort, one could either construct or choose an existing simple and yet realistic NWP model for experimentation. If an existing model is adopted for the pilot project, certain reprogramming may be needed. But even in the initial phase, the model should be placed in a program environment to take advantage of conventional software tools, off-the-shelf graphics, and user interfaces such as the X Window System.

Phase II: In Phase II, the validated massively parallel algorithms will be implemented for an operational-type mesoscale NWP model (e.g. Madala & Chang). Test cases shall be conducted on the final version of the model to demonstrate model

performance.

AF93-101 TITLE: High Resolution Ultraviolet Sensor

CATEGORY: Basic Research

OBJECTIVE: Develop a high spatial resolution ultraviolet sensor suitable for a space vehicle.

DESCRIPTION: Innovative approaches are solicited for the development of an ultraviolet imager that is suitable for a space vehicle for the detection and tracking of space objects. Mid and near UV wavelengths are to be considered. Currently employed UV imagers have as their main components a collecting telescope, an intensifier, and a CCD video camera. In such an imager the greatest loss in spatial resolution is in the intensifier. But an intensifier is used for the detection of weak sources. How to overcome this problem is the nature of this topic.

Phase I: Efforts in this phase shall consist of the investigation of concepts that may have the potential of overcoming the above problem. This effort is primarily theoretical but any laboratory work proposed to support a concept is welcomed.

Phase II: Efforts in the second phase shall consist of research leading to the design of the desired sensor, a laboratory model of the sensor and the testing of the sensor characteristics.

AF93-102 TITLE: Heated Cloud Rise Model

CATEGORY: Basic Research

OBJECTIVE: Develop a computer model suitable for predicting the stabilization height, dimensions, and position of a large, thermally buoyant cloud.

DESCRIPTION: A computer model is needed for predicting rise rates, stabilization heights, dimensions, and positions of large, thermally buoyant clouds. Such clouds are produced during the testing and launching of space launch vehicles. Output from the cloud rise model will initiate atmospheric dispersion modeling of down wind cloud concentrations. The model needs to account for several types of cloud sources such as nominal launches, nominal ground tests, propellant burns, and vehicle aborts. The model must consider cloud interaction with inversion layers, wind shears, and other relevant meteorological factors at the release site. It also must account for chemical reactions occurring within the cloud that will effect cloud rise.

Phase I: The desired Phase I product is a preliminary computer code suitable for evaluation.

Phase II: The desired Phase II product is a completed and validated computer code capable of providing specific cloud stabilization height, dimension, composition, and position information.

AF93-103 TITLE: Closed Cycle, Closed Loop Multi-Functional Cleaning Machine

CATEGORY: Basic Research

OBJECTIVE: Design and construct an innovative, totally enclosed, recyclable, multi-functional cleaning machine.

DESCRIPTION: A drop-in freon solvent substitute for precision cleaning of strategic guidance systems is yet to be found. CFC-113 (freon) another ozone layer depleting substances (OLDS) are being phased out ata rate that is much faster than originally planned. As new information on ozone layer depletion is acquired the phase out rate increases. Many of the potential fluorocarbon substitutes for freon are very expensive, $12 to $25 per pound. Membrane filters are available that will filter out solvents, return the filtrate to the system, and expel environmentally acceptable air. These filters are as efficient in separating OLDS as they are in separating the new expensive solvents. Sweep frequency ultrasonics have been shown to be most effective as cleaning mechanisms, and have been shown to be safe to use in cleaning electronic hardware. New Fluorocarbon surfactants have been shown to be more effective than freon as particulate contaminate removal agents, particularly when used in connection with the new ultrasonic transducers. Super critical fluid cleaning processes (particularly super critical CO2) have been shown to be most effective in cleaning metal parts of hydrocarbon and bromine fluid contaminates. SC CO2 processes have been developed to clean complex metallic/epoxy containing parts and remove absorbed CO2 from the epoxy components (if removal is required). All these developments now make it possible to design, fabricate, test and place in production an innovative multi

functional cleaning system that will allow the cost effective use of the new expensive solvents, that will facilitate application of new processes and even allow the use of stockpiled OLDS in an environmentally acceptable manner. A suggested philosophy of design is to bring the cleaning mechanism to the part to be cleaned rather than bringing the part to the cleaning mechanism.

Phase I: Efforts will include complete design together with selected feasibility demonstrations.

Phase II: Efforts will include the fabrication, testing, and placing the multi functional machine in use in a production environment.

AF93-104 TITLE: Manufacture of Stator and Rotor Laminations/Cores for Missile SFIR Assembly

CATEGORY: Basic Research

OBJECTIVE: An innovative process for the manufacture of SFIR stator and rotor laminations/cores used in missile guidance systems.

DESCRIPTION: An innovative/efficient manufacturing process is required for manufacture of precision stator and rotor laminations/cores used in strategic guidance system components. The laminations are made from cold rolled sheet nickel-iron alloy, ranging from 0.003 to 0.010 inch in thickness, and displaying specific magnetic properties. Sizes range from 1 inch to 2.5 inches in diameter and tolerances of +/- 0.001 inch are common place. Current methods of manufacture are photo etching and precision stamping, together with required de burring and other finishing processes. Electric discharge machining and laser cutting are not acceptable on the basis that these methods alter the electromagnetic properties of the material. Alternate cost effective (small volume) high precision methods of manufacture should be investigated. Final vendor approval by the responsible Air Force Design Activity will be necessary. The background document relating to this SBIR solicitation topic provides examples of the required SFIR laminations/cores and responsible Air Force Design Activity contact. Potential SBIR contractors are advised that portions of the background statement contain documents that are subject to EXPORT CONTROL LAWS and procurement of the background statement places the recipient under appropriate restrictions. The DTIC background document related to this solicitation topic contains instructions for U.S. citizens to obtain the export control related background document. The following statement will appear on the background paper:

"This document contains information for manufacturing or using munitions of war. Export of the information contained herein, or release to foreign nationals within the United States, without first obtaining an export license, is a violation of the international traffic in areas regulation. Such a violation is subject to a penalty of up to 2 years imprisonment and a fine of $100, 000 under 22 USD 2778."

Phase I: Efforts in this phase will include investigation of potential manufacturing processes together with demonstration of the applicability of the selected process in concurrence with the responsible Air Force Design Activity.

Phase II: This follow-on phase shall result in the manufacture and approval selected rotor and stator laminations and cores.

AF93-105 TITLE: Reentry Environment Phenomenology

CATEGORY: Basic Research

OBJECTIVE: Develop Hypersonic Reentry Phenomenology Related to Methodology of Compensation Capability to Enhance Electromagnetic Transmission for Advanced System.

DESCRIPTION: Future reentry systems may be incorporating sensors to fulfill mission requirements. Development of techniques for employing advanced sensors and guidance in the hypersonic reentry environment meets with many significant challenges. At a minimum, antenna window heating and the resultant changes in the electromagnetic properties, antenna material ablation and local plasma are all key factors in the operation of a sensor. Approaches are sought which would lead to methodology or compensation capability which could alleviate the effects of reentry on RF transmission.

a. For example, employment of a strong magnetic field around an antenna window might be feasible with room temperature super conductor materials. Other techniques including material ejectants or alternate concepts may also be candidates.

b. Another approach which may be included in the sensor system concepts is the compensation for the environment that accompanies hypersonic reentry. Options for local environment sensing might be integrated into a sensor system allowing for real-time compensations to be included sensor updates. Options to be considered should include the ability to compensate for temporal as well as spatial effects of the hypersonic reentry environment over the sensor aperture.

c. Development of sensor systems for hypersonic reentry will need to be supported by effective and cost efficient ground

test capabilities to support test and evaluation short of full scale flight test. The test conditions that need to be simulated are the boundary layer fluid, thermal and plasma profiles to sufficient fidelity to allow antenna window sensor testing during simulated environmental conditions.

d. Analyze available reentry vehicle flight data to provide an understanding of flow field plasmas for hypersonic vehicles at angle of attack. Non-zero angles of attack can produce significantly higher plasma on the vehicle lee side for simple conic geometries. However, the lee side from a standpoint of lower heating is a likely location for antenna windows. Additionally, in the lower altitude regime turbulent flow characteristics need to be included. Further, the effort should explore these concepts and how they would translate to analyzing more advanced configurations of a lifting body or glide vehicle.

Phase I: The first phase efforts would explore several alternatives and provide strong and weak points.

Phase II: Efforts in the second phase would develop the chosen methodology and provide a proof of concept in a ground test facility.

AF93-106 TITLE: Innovative Navigation for ICBM Applications

CATEGORY: Basic Research

OBJECTIVE: Identify and investigate alternative guidance and navigation sensors, update schemes, and processors for ICBM applications.

DESCRIPTION: The following subtopics cover specific areas of interest. Note, proposals must specify subtopic by both topic number and subtopic letter designation.

A. Navigation Update Sensors: Strategic grade inertial instruments are complex and very expensive. As a result, strategic guidance and navigation systems relying solely on inertial instruments for navigation are difficult to acquire, maintain, and service. If this reliance on purely inertial reference is reduced, a potential savings in cost and complexity arises. Several techniques have been proposed to this end, including stellar, radar, and satellite navigation updates; however, new and innovative sensors are still being sought.

Phase I: Attempt to identify additional update schemes or sensors and perform a sound analysis illustrating the feasibility and potential accuracy of each component.

Phase II: Involves further investigation, exploratory testing, or simulation as necessary to demonstrate the proposed concept.

B. Guidance And Navigation Signal Processors: With the inclusion of update information, as described above, the load on the guidance computer becomes markedly increased. Efficient algorithms are required to incorporate navigation updates, making best use of processor capability. More efficient processing of update and inertial sensor data is also of interest. Parallel processors and neural networks are examples of architectures that could be applied to many functions of guidance, navigation, and control.

Phase I: Present an innovative approach to the problem of processing the data required of an advanced ICBM guidance system or some component thereof.

Phase II: Includes further investigation, testing, and simulation demonstrating the proposed concept.

C. Optical SAR Processing: Future ICBM reentry systems may incorporate advanced SAR sensors. These sensors must be able to process data in real-time in order to be useful in a hypersonic vehicle. SAR processing is characterized by transforms that are well suited to optical or hybrid processors. These processors must survive and operate in the harsh, high temperature and acceleration environment of a reentry vehicle when used in an ICBM application.

Phase I: The objective shall be the definition of an optical or hybrid processor tailored to ICBM applications. The proposed architecture should show significant advantages in processing speed, processor size and power requirements over conventual architectures. Options for processor architectures and their technological maturity must be assessed.

Phase II: Provide proof of concept along with sizing and power issues as applicable to future vehicle configurations.

D. Micro-Inertial Systems: Micro-machine technology advances have shown the potential for producing arrays of accelerometers and gyroscopes in a 3-axis assembly. These devices may provide inertial guidance in a range of military and civilian systems. Currently, these devices are limited by the precision inherent in the instruments themselves, hence limiting options for their use in long range, unaided strategic systems. Due to the small size of these instruments, several may be packaged in an array. The individual sensor output in the arrays can be statistically combined to eliminate uncorrelated errors.

Phase I: Identify algorithms and combining techniques to meet this end. Detailed analysis must show the feasibility of these techniques given the micro-instrument production and packaging technology available. Assess potential precision of such configurations.

Phase II: Demonstrate the concepts developed in Phase I through further analysis, development, simulation and

prototyping.

AF93-107 TITLE: Interference Immune Retrodirective Array

CATEGORY: Basic Research

OBJECTIVE: To develop jam-resistant retrodirective antennas for air-to-air/ground communication links.

DESCRIPTION: Covert communications capabilities are needed by special operations forces aircraft to send and receive voice and relative navigation information. Likewise, jam-resistant communications and data links are necessary if navigation information is to be transferred for precision targeting of high value targets. Retrodirective antennas can be important keys for transmitting and receiving in these threatening environments. The advantages of these antennas include higher directive gain, automatic tracking, lower probability of intercept and detection, and jam immunity. This effort would be directed towards the development of airborne and ground based phased arrays with full duplex capability. These arrays could contain 8 to 16 elements and would have the capability to receive and transmit pseudo-noise code waveforms. Undesired signals would be suppressed by up to 30 decibels (Db). Because of the high dynamic environment of the airborne arrays, the cost of adding new aircraft antennas, and the expendability of the ground based arrays, these designs need to track quickly through low cost means. Under Phase I, the contractor shall determine requirements for the retrodirective arrays, and develop candidate designs. For Phase II the contractor shall prove one of the design concepts with a breadboard system that adequately demonstrates the desired performance. The goal of Phase III is to advance the technique sufficiently to support an operational capability.

AF93-108 TITLE: Ontogenic Neural Networks for Avionics Applications

CATEGORY: Basic Research

OBJECTIVE: Develop an ontogenic neural network paradigm and define its applicability to a specific avionics problem.

DESCRIPTION: Ontogenic neural networks are those which automatically evolve their structures as they determine their own optimum topology during network synthesis. The genetic ability distinguishes ontogenic neural networks from traditional neural network paradigms which require the user to become an integral part of the learning algorithm. As a result, ontogenic modeling approaches result in true machine learning strategies. There are several avionics applications where the development of a robust ontogenic modeling algorithm may afford substantial benefits. These include, but are not limited to threat response and countermeasure recommendation, pilot aiding, sensor fusion, target identification, and signal processing. During this effort, the benefits of an existing ontogenic neural network paradigm will be demonstrated for a specific avionics problem. The ontogenic paradigm, as a minimum, will have the following characteristics: completely self-organizing without any human intervention; the ability to learn quickly, the ability to represent extremely high order relationships, and the capability to represent conditional relationships at the node travel (i.e., nodal interaction among inputs). In addition, potential areas of algorithm improvement (e.g., increased automation, tailored modeling criteria, global optimization) shall be identified and preliminary algorithm enhancement will be performed. Also, the potential use of modeling heuristics, possibly in the form of a production-rule system integrated with the ontogenic learning algorithm, will be investigated. These areas of algorithm improvement will be documented as part of the Phase II technical approach. Phase I will identify an existing ontogenic or near-ontogenic neural network paradigm which meets the above requirements, develop a feasibility demonstration for a contractor selected avionics problem and perform an initial investigation of the enhancement of the paradigm as described above. Phase II will implement the improvement plan documented during Phase I, and will result in a prototype system suitable for testing in a government avionics laboratory and/or operational environment. The goal of Phase III is to advance the system sufficiently to support an operational capability.

AF93-109 TITLE: Avionics Software Design Complexity Measure (ASDCM)

CATEGORY: Basic Research

OBJECTIVE: Develop the capability to predict the design complexity of avionics software.

DESCRIPTION: The cost to develop and maintain software is increasing at a rapid rate. Of the total cost to develop the software, the majority of cost is spent in the post-deployment/maintenance phase of the software life cycle. More effort needs to be spent in the earlier phases of the software life cycle in order to produce more maintainable software and to reduce development cost. One measure of software maintainability is the complexity of the software design. The ability to objectively measure the design complexity of the software (which would result in a means of comparing software designs), would be advantageous to the software developer. Currently, metric analysis is performed at the implementation phase on the code itself, if at all. If a change in the design is necessary, the entire design and development effort would be repeated, possibly resulting in endless iterations of design/code redevelopment. This effort will serve to shorten this "iterative" process to the point where the design of the code is what is analyzed, not the resulting software. Additionally, the effort will provide the Air Force benefits in terms of a shorter software development life cycle, a quantitative measure of software design complexity, which in turn will potentially reduce maintenance costs. Work for this effort will be divided into two phases. Phase I will identify what is currently available and applicable to avionics software in terms of design complexity measurement and defining what is not covered by the currently available measures. New techniques will be defined in this phase. In addition, this phase will investigate methods for performing design complexity measurement. Phase II will emphasize the development of a system for automating the process of measuring the design complexity of avionics software. The goal of Phase III is to advance the system sufficiently to support an operational capability.

AF93-110 TITLE: Digital Signal Processing for Networked Communications De-interleaving

CATEGORY: Basic Research

OBJECTIVE: Develop new signal processing algorithms combined with existing radar processing algorithms to process communications signals.

DESCRIPTION: Modern communications signals are often networked or in a multiple access format to allow several users to occupy a limited bandwidth simultaneously. Possible multiple access formats would include Frequency Division Multiple Access, Time Division Multiple Access and Code Division Multiple Access. Spread spectrum formats such as frequency hopping or direct sequence can be used to perform multiple access. In such a signal environment, which may be corrupted with noise and interference, tracking individual users with limited prior knowledge of their signal is a very difficult task. Several radar processing algorithms have been developed which are used to determine parameters on radar pulses for sorting purposes. These algorithms, combined with developed communications specific algorithms, could be used to track and de-interleave communications signals. Such algorithms would need to process signals based on time-of-arrival (TOAs) and other precision-measured signal parameters which may appear random, staggered, or embedded in other users' signals. Under Phase I, the contractor will examine existing radar-based algorithms and determine the upgrades/modifications required to process and track communications signals. The contractor will determine other fundamental sorting parameters (such as fine frequency measurement) for the signal formats of interest. At the conclusion of Phase I, the contractor will produce a final report documenting results and conclusions. Under Phase II, the contractor will implement the algorithms into a computer workstation hosted signal processing system, developed from commercial, off-the-shelf equipment. Phase II will result in a system demonstration using live signals plus a final report. The goal of Phase III will be to embed these algorithms into an operational system.

AF93-111 TITLE: Reconfigurable, Real-Time Radar Warning Receiver (RWR)

CATEGORY: Basic Research

OBJECTIVE: Develop a cost-effective, modular, high-fidelity, reconfigurable, real-time simulation of radar warning receivers (RWR).

DESCRIPTION: A cost-effective method of modeling the full range of radar warning receivers with a high-fidelity, real-time simulation is essential to the efficient development and evaluation of integrated defensive avionics. Past RWR simulations have been designed as clones of individual RWRs and do not operate in real-time. This approach limited their flexibility since it required extensive modifications to model a different RWR and to operate in real time. Usually, real-time operation sacrifices fidelity. This topic area seeks to exploit the technology opportunity presented by recent advances in high-speed digital processors and parallel processing architectures to develop a truly reconfigurable, real-time RWR simulator. A reconfigurable, real-time

RWR simulator would make the acquisition process more efficient by providing a cost-effective method for early evaluations of proposed RWR concepts and improvements. The simulator would also provide high-fidelity technology for training and readiness. A successful approach needs to address all aspects of RWR processing functionality: waveform characterization, data correlation, identification, emitter tracking, mode changes, hardware/software architectures, etc. Additionally, the approach needs to address the real-time performance issues associated with the design. Under Phase I, the contractor shall develop a preliminary design with an analysis of feasibility and cost/fidelity trade-offs for the various simulation functions. Performance demonstrations of critical aspects of the design are desired to evaluate risk in proceeding with Phase II. Under Phase II, the contractor shall fabricate, demonstrate, and evaluate the document and the proposed design. Together with the delivery of the system, the contractor shall provide recommendations for further development. The goal of Phase III is to advance the technique sufficiently to support an operational capability.

AF93-112 TITLE: High Performance, Economical Frequency Synthesizer

CATEGORY: Basic Research

OBJECTIVE: Develop and demonstrate a microwave frequency synthesizer design with improved performance and low cost.

DESCRIPTION: Microwave Radio Frequency (RF) synthesizers are commonly used in modern electronic countermeasure (ECM) systems. Synthesizers using up-conversion offer coherence and low phase noise and spurious products. However, settling time has been 500 nsec to 1 usec. Because mixers are used in the signal path, high-performance microwave filtering is necessary to maintain spectral purity. These designs are inherently complex and thus costly. Direct Digital Synthesis (DDS) has offered a less costly alternative with fast tuning, but spurious content is inherently poor (<50 dBc) and pulse-to-pulse coherence is not offered. Also, both designs provide poor FM range (typically 100 MHz) at the low end of the RF bandwidth. A wideband synthesizer in which the RF is produced without the previous strict reliance on up-conversion or digital synthesis would eliminate the complexity and high cost of up-conversion schemes, and the poor spectral purity of DDS approaches, yet still provide the fast switching of DDS and the coherence of the up-conversion approaches. Under Phase I, the contractor shall design a digitally controlled synthesizer with the following parameters:

Frequency Range	0.5-20 GHz
Frequency Resolution	<125 kHz
Switching Speed	<300 nsec
Harmonic Spurs	<-60 dBc
Nonharmonic Spurs	<-70 dBc
Phase Noise	<-64 dBc @10 kHz from carrier
	<-100 dBc @1 from carrier
FM Tuning Range	>250 MHz
Amplitude Range	0 to 60 dB
Amplitude Resolution	0.5 dB
Ampl Accuracy vs. Range	+0.5 dB
Ampl Accuracy vs. Freq	<0.6 dB
Service Conditions	+12 to +32 C
Size/Weight	<0.5 ft /<20 lb
	(Power Supply Excluded)
Simulate Multiple Pulse Doppler Signatures with Phase Errors of no greater than 1	
Power Output	0 dBm +3 dB

Phase I shall include a report that synopsizes the effort and estimates production costs compared to available synthesizers, with a goal of 25 to 50% cost savings. Phase II shall provide a brassboard microwave RF synthesizer and acceptance test plan. The Phase II report shall also provide detailed cost and options for production units. The goal of Phase III is to provide synthesizers for a wide range of applications such as, ALQ jammer pods, B-1, EF-111, radar simulators, radar test ranges, shipboard jammers, local oscillators for antiradiation missiles, transmitter exciters for coherent adars, and other commercial applications.

AF93-113 TITLE: Superconductor Digital Electronic Warfare (EW) System Development

CATEGORY: Basic Research

OBJECTIVE: Develop wideband digital superconductor subsystems with adequate performance for EW systems applications.

DESCRIPTION: Superconductivity enables systems to be produced with higher operating frequency, wider bandwidth and lower power dissipation than conventional passive microwave device and digital semiconductor technology. Great success has been achieved in producing low temperature superconductor (LTS) digital components at liquid helium temperatures (4.2 Kelvin); however, liquid helium coolers are impractical for airborne EW system applications. Recent advancements in Rapid Single Flux Quantum technology make digital high temperature superconductor (HTS) technology a real possibility. This effort will explore wide bandwidth digital superconductor concepts supporting EW systems operating over the full 2-20 GHz band. Proposed LTS development will only be acceptable if designs are directly transitionable to HTS technology in the future. One high payoff digital EW application potentially having the broadest application is a wideband digitizer. The digitizer should possess at least 6 effective bits of resolution and 4 to 6 GHz bandwidth. Ultra high speed signal processing subsystems that can process the output of this extremely high speed digitizer will also be required. Signal processors of interest include digital filters, correlators, fast fourier transformers, and single-sideband modulators. Demultiplexers and multiplexers will be needed for interfacing wideband superconductor A/D and D/A components with slower speed semiconductor memory and processors. Under Phase I of the effort, the contractor will develop, or continue development of high payoff components which will support a wideband digital EW system able to operate over 2-20 GHz. The contractor will also produce a final report documenting results and conclusions. Under Phase II, the contractor will further develop parts of the digital EW system and begin integrating components. A demonstrated system or subsystem will be the goal of Phase II. At the conclusion of Phase II, the contractor will produce and deliver a final report documenting results and conclusions along with a hermetically packaged operational subsystem with input and output connectors. The goal of Phase III is envisioned to develop and integrate more complex system concepts which may include HTS implementation where appropriate.

AF93-114 TITLE: Advanced Fire Control/Fusion Methods

CATEGORY: Basic Research

OBJECTIVE: Develop advanced fire control algorithms for air-to-air and air-to-ground internetted applications.

DESCRIPTION: Recent hardware and software advances in the areas of electronically scanned array radar, multiple target tracking intraflight datalinks, passive sensors, and advanced processors have led to increased weapon system capabilities and tactics not possible before. These advances have also led to increased complexity in handling the information obtained from the application of these new technologies. The use of a datalink to internet aircraft within a flight will significantly change the interaction between those aircraft if fully utilized. The internetting capability enables new passive fire control techniques that could be exploited under this effort. Fusion of data from different sensors and between aircraft will enable multi-ship precision targeting through the reduction of target location errors. Future aircraft will be required to be less specialized and handle a wider variety of missions including both air-to-air and air-to-ground engagements. These aircraft should be able to accept in-flight information from off-board sources that could affect their basic mission parameters. These data may include cues to target positions, intelligence updates on target characteristics, or even changes in primary targets. The algorithms that manage all of these data and the internetted operations of the aircraft should increase reliability and efficiency through the ability to utilize information from other aircraft. For instance, if an aircraft experienced a sensor failure during an operation, the mission could continue if that aircraft was able to utilize targeting information from other aircraft in the flight. Redundancy in sensor coverage and time critical tasks could also be reduced by an adaptive allocation of all resources within a flight. This will increase efficiency, capability, and situational awareness. The objective of this effort is to develop advanced fire control and fusion algorithms that will significantly enhance the capability of aircraft within the internetted environment. Specific areas of interest within internetting include intraflight sensor fusion, and intraflight sensor management. The algorithms developed should be applicable to both air-to-air and air-to-ground engagements. Under Phase I, the contractor shall develop and evaluate approaches to increase the fire control and fusion capability over existing methodologies. The approaches will be evaluated against measures of performance such as performance gain and processing requirements. At the conclusion of Phase I, the contractor shall produce a final report documenting results and conclusions. Under Phase II, the contractor shall implement the selected algorithms and perform detailed evaluations of their performance. The goal of Phase III is to advance the technique sufficiently to support an operational capability.

AF93-115 TITLE: Active Expendable Electronic Counter-Countermeasures (ECCM)

CATEGORY: Basic Research

OBJECTIVE: Develop ECCM techniques to counter active expendable electronic countermeasures (ECM)

DESCRIPTION: With the ever increasing number of countries getting into the military equipment sales, the rest-of-the-world (ROW) ECM threat is growing daily. There are many varieties of active expendable ECM threats available for sale to anyone with the money to purchase them. Active expendables are inexpensive radiators that mimic a radar signal. These expendables can also have a reasonable radar cross section (RCS) that resemble the aircraft that has expended them in an attempt to avoid/break weapon system lock-on. This effort will explore innovative ECCM approaches to counter the active expendable threat. Under Phase I of the proposed research, the contractor will investigate and define new ECCM techniques that will counter the active expendable ECM threat and the potential Terrain Bounce threat. At the end of Phase I, the contractor will be required to produce a final report which documents the investigation and definition of these new ECCM techniques. Under Phase II of the proposed research, the contractor will fully develop and evaluate the technique(s) that showed the greatest potential for success in Phase I. At the conclusion of Phase II, the contractor will produce a final report which documents the technique(s), as well as possible future enhancements. Also, a recommended test demonstration approach for the technique(s) will be presented. The goal of Phase III will be to advance the technique(s) sufficiently to support an operational capability.

AF93-116 TITLE: Automatic Target Recognition (ATR) Research

CATEGORY: Basic Research

OBJECTIVE: Develop target and background synthetic image capability for high resolution radar and laser radar sensors.

DESCRIPTION: The development of ATR algorithms is dependent on the ability to synthesize and validate target and background signatures. ATR algorithms must be able to efficiently access these signatures to match stored signatures to sensed signatures and must be able to estimate underlying signature parameters such as target pose or target/sensor motion to facilitate the matching process. Both air-to-air and air-to-surface algorithms are of interest using radar, IR, and laser sensors. All Phase I efforts shall result in a proof of concept and a Phase II proposal. At the end of Phase II, the contractor shall demonstrate and deliver the developed technique/capability/tool. The goal of Phase III is to advance the technique sufficiently to support an operational capability. We are seeking solutions to one or more of the following topics:

1) Evaluate model validation metrics to compare high fidelity 1-D, 2-D, and 3-D measured signatures with model predicted high resolution RF target signatures of ground and air targets (model and measurements provided).

2) Develop aircraft radar, radio and navigation antenna (UHF to KU band) models to predict high frequency RF band scattering responses including interaction with aircraft structure (e.g., radomes, antenna covers, exterior, interior, etc.).

3) Develop automated geometry measuring device to measure large objects such as aircraft and ground vehicles for use as input geometry (2-mil accuracy desired) to signature modeling codes. Also desirable to measure surfaces and structures obscured by RF transparent and absorbing materials.

4) Develop data compression techniques to quickly and accurately reproduce signatures using small memory requirements. Offline computation can be traded for on-line efficiency. Low or no loss schemes desired.

5) Develop computer visualization capability to overlay target wireframe on 1-D, 2-D, and 3-D data representations using combinations of angle, angle range dimensions afforded by such sensors as FLIR, laser, and 2-D, and 3-D synthetic aperture radar sensors.

6) Develop total scene simulated imagery capability of FLIR and 3-D laser sensors as sensed from an airborne platform in an air-to-surface tactical target (e.g., tanks) attack scenario. Environmental effects such as fog, dust, and atmospheric turbulence, sensor effects such as sensor pointing jitter, and target/background effects such as target reflectivity variations due to surface roughness and incidence angle should be considered.

7) Develop motion estimation algorithms that estimate sensor motion, independent target motion, and 3-D structure from motion using FLIR imagery.

AF93-117 TITLE: Application Specific Electronic Design Synthesis

CATEGORY: Basic Research

OBJECTIVE: Develop computer aided design tool which automates the design of related electronics in AF systems.

DESCRIPTION: The Air Force continuously develops complex electronic components and systems for its weapons. These designs utilize many common engineering facets in the areas of functionality and electronic technology. For example, there may be commonality in applications which require data or signal processing or in algorithmic functions, such as filters or transforms. All systems are made up of components such as processors, memories, bus interconnections, and protocols. Systems can also have commonality in electronic technologies used, such as analog or digital and synchronous or asynchronous logic. This topic seeks to develop software tools to perform the automated design, also known as synthesis, of one or more of these common engineering areas. Application areas addressed should be those most relevant to AF systems and the relevancy should be clearly described. It should be shown that the tool to be developed will be easier to use, produce a design significantly more rapid than current methods, handle more complex designs and yield a better optimized design. It should be shown that the technology to be developed does not duplicate current commercial off-the-shelf solutions. Inputs to the tool should be reasonable and natural for the particular design area, i.e., specific to the application and not the implementation. Outputs from the tool should be suitable for design analysis and for direct and immediate progression to the next level of implementation detail.

Phase I: Phase I of this effort will be to do the preliminary design of such a tool.

Phase II: During Phase II the tool will be constructed, evaluated and demonstrated. Reference manuals and user guides will be developed.

Phase III: In Phase III the tool will be integrated into widely used design environments, readied for market and beta tested. Production and support plans will be developed.

AF93-118 TITLE: High Temperature Packaging/Interconnect with Metal/Ceramic Bonding

CATEGORY: Basic Research

OBJECTIVE: Develop and test methods of bonding metals and ceramics together in high temperature electronic packages.

DESCRIPTION: A number of electronic initiatives have encountered difficulty with their interconnects, bonding and packaging at higher temperatures. Traveling wave tubes have the need to connect SiC or diamond films to copper and other materials for use in heat sinks. In phased arrays and other systems requiring modules, several materials are often bonded and require thermal, electrical, and mechanical continuity. In the case of SiC and diamond semiconductors, the electronic properties of the material still function long after the bonding and interconnects have failed. A series of recent developments show how dissimilar materials may be strongly bonded over a very wide temperature range without compromising thermal conductivity, electrical continuity, or mechanical integrity. For some using a single step brazing method can fasten dissimilar materials from 0-1000 degrees Celsius, even under the most severe thermal shocks. For large area thermally-cyclic systems, methodologies have been developed to minimize stresses for the best possible bonding. Much of the work in this area has already been demonstrated for the materials of interest, but little has been done to apply it to specific systems. It is mainly a question of identifying where problems presently exist and determining if these new bonding methods can be applied.

Phase I: In Phase I emphasis will be placed on identifying which type of packaging and interconnect problems exist presently which can be remedied by the new bonding methods.

Phase II: Phase II will focus on demonstrations of improved bonding and interconnects for a variety of targeted problem areas.

Phase III: In Phase III the contractor should develop new and unique packaging designs and methodologies taking advantage of the new materials and bonding techniques. The program deliverables will be a technical report outlining the new bonding methods, where these bonding methods may be applied and the results of applying these new methods to specific needs.

AF93-119 TITLE: Automated Defect Analysis Using Image Processing Techniques

CATEGORY: Basic Research

OBJECTIVE: Produce prototype system which performs highly automated quantitative defect analysis of processed/unprocessed semiconductor materials.

DESCRIPTION: Automated defect analysis is needed for semiconductor and other materials both in R&D and manufacturing technology. Limited automation exists for quantitative analysis of the sizes, shapes, orientations, distributions, and numbers

of surface defects, such as etch pits and oval defects, which can occur in densities from 1 to 10 to the 6 power defects/cm squared. This type of work is typically performed manually with microscopes or photomicrographs. Current image processing techniques have the capability to perform some quantitative analysis, although further development may be required. The benefit of such capabilities would be the improvement of defect metrology in the R&D community, improved materials qualification techniques for vendors and users, and spin-off technology in image processing instrumentation and techniques.

Phase I: Phase I is envisioned as a feasibility effort to determine the capabilities of image processing techniques to quantify size, shape, and distribution of defects; to design a modular system consisting of image acquisition, image processing and sample positioning and registration; and to address instrument limitations, such as resolution and contrast.

Phase II: Phase II would involve the construction and demonstration of a device capable of quantitative defect analysis across entire sample surfaces thereby providing a high speed, high quality testing capability.

Phase III: Phase III will consist of final development and test of a commercial product.

AF93-120 TITLE: Machine Thinning of Gallium Arsenide (GaAs) Wafers

CATEGORY: Basic Research

OBJECTIVE: Develop and refine precision surface machining technology and apply it to GaAs wafer thinning

DESCRIPTION: This program will assess the cost and/or RF performance advantages of GaAs wafer thinning by one-pass machine cutting as compared to GaAs substrate backside lapping and polishing as is presently practiced in industry. The scope of the program includes effort in the refinement of diamond turning machinery to achieve GaAs wafer thickness, surface flatness, and parallelism exceeding the quality of present lapping and polishing practices.

Phase I: Phase I of this effort will include implementation of necessary modifications and refinements to present surface cutting machinery in order to achieve wafer thickness control, flatness uniformity and throughput exceeding present GaAs substrate backside thinning methods. Phase I will also include the investigation and characterization of machine thinned, bare GaAs substrate acquired as experimental samples. Full physical, and electronic characterization (e.g., surface roughness, subsurface damage, changes in mobility, etc.) of the thinned GaAs substrates to assess damage or degradation will be required.

Phase II: During Phase II, after completing all necessary machine refinements, the contractor shall machine-thin representative GFE processed and tested wafers. The objective of this exercise will be to compare the DC and microwave RF performance of these machined wafers to sets of control wafers that were backside processed by standard methods. The contractor must consider any special care or handling of these thinned wafers and any additional treatment, such as touch-up etching that might be required before further processing. The contractor shall consider automation, manufacturing yield, and unit cost as major factors in this development effort with the objective of replacing wafer thinning by lapping and polishing with more accurate and less expensive methods.

Phase III: Phase III shall consist of implementation in a production environment and assessment of final yield and cost data.

AF93-121 TITLE: Gallium Nitride (GaN) Device Development

CATEGORY: Basic Research

OBJECTIVE: Develop detectors, active waveguides, lasers, and/or optoelectronic components based on gallium nitride III-V materials.

DESCRIPTION: III-V gallium nitride has several potential advantages over other semiconductor material systems. The material has matured to the point where the material properties may be exploited in detectors, active waveguides (switches and modulators), lasers and/or optoelectronic components including cellular arrays. The Air Force has applications for ultraviolet detectors and lasers, multiwave mixing devices, optical interconnects, and blue lasers. Integration with other III-V compounds, like gallium arsenide is feasible. The prospective contractor should draw on existing III-V material technology in proposing a device or devices which offer an opportunity to use the unique properties of gallium nitride.

Phase I: Phase I should establish the feasibility of the proposed device and should, at a minimum, demonstrate a basic device structure.

Phase II: Phase II would produce an optimized device or devices and establish processing and fabrication techniques for the device or devices.

Phase III: Phase III will develop a production prototype of the device or devices and demonstrate integration into active waveguides.

AF93-122 TITLE: Particle Microsensors

CATEGORY: Basic Research

OBJECTIVE: Develop new and innovative in situ particle microsensor devices for semiconductor manufacturing.

DESCRIPTION: Semiconductor device fabrication facilities are increasingly dependent on real-time sensors and process controls for first-pass success in the fabrication of complex semiconductor devices and integrated circuits in small quantities. The trend in advanced device manufacturing is moving toward single-wafer processing using all dry plasma processes for deposition, etching, etc. As more complex devices and processes are developed, real-time sensors and process control become even more critical. In many cases special sensors are needed, since these devices must frequently operate in a plasma or a reactive-gaseous environment at elevated temperatures. Real-time, in situ sensors for the measurement of 0.1 - 10 micrometer particles generated during plasma processing are a critical problem area. Conventional optical scatterometer techniques for measuring particle densities in a flowing gas stream are no longer adequate. Techniques of counting particles on wafers during postprocessing microscopic inspections are also not adequate. In situ microsensor devices using new approaches and/or phenomena to detect particles on a wafer in the above environments are urgently needed.

Phase I: Phase I will consist of a 6-month feasibility investigation to design a new microsensor particle detector device. It is highly desirable that this device be capable of being integrated with digital signal processing devices on a single semiconductor chip. Proposed device designs should be theoretically analyzed to determine the technical feasibility of the design approach including sensitivity, range of detection, linearity, ease of fabrication, cost, and applicability to the above problem. Preliminary laboratory measurements to demonstrate technical feasibility of the approach should be performed and discussed in the final report.

Phase II: Phase II of this effort will consist of 24 months of additional work to perform detailed device design, fabrication, and demonstration. Measurements should be made to determine the limits of performance, operating parameters, and benefits of this design over competitive approaches.

Phase III: Phase III will develop a production prototype of the device and demonstrate the device in actual semiconductor production equipment.

AF93-123 TITLE: Flight Control Science and Technology

CATEGORY: Basic Research

OBJECTIVE: Develop flight control science and technology to support air power projection and/or Precision Strike.

DESCRIPTION: Develop one or more of the following advanced flight control technologies for future aircraft: a) control effectors (moment generators) that reduce or eliminate the need for conventional control surfaces, b) design criteria for new generation pilot displays and landing aids that account for the effect of visual cues on aircraft flying qualities, c) devices that facilitate extended maneuvering envelope stability and control testing in existing Air Force aerodynamic research facilities such as the Wright Laboratory's Vertical Wind Tunnel, d) control system configurations for nonlinear and time varying flight conditions, e) neural network and/or fuzzy logic based adaptive control, f) analytically derived designs for rate, attitude, and position control laws, g) computationally efficient flight management algorithms for real-time all weather guidance of combat aircraft, h) on-board system diagnostics concepts for highly integrated vehicle management systems, i) real-time, high-fidelity multisensor image fusion software for piloted vehicle control, j) non-obtrusive air data measurement for high-speed vehicles, k) structural response feedback techniques for flight control, l) aerodynamic, structural and propulsion data measurement for hypersonic vehicle control.

AF93-124 TITLE: Innovative Low-Cost, Lightweight Structural Concepts

CATEGORY: Basic Research

OBJECTIVE: Utilize advanced materials, manufacturing and design techniques to develop innovative, low-cost, lightweight structural airframe concepts.

DESCRIPTION: Over the past several years, significant advances have been made in the areas of engineered materials (e.g., composites), net or near-net shape manufacturing methods, and design concepts. Of these areas, engineered materials, which are designed to have specific characteristics, may possess the most far reaching potential for achievement of revolutionary advancement in structures technology. Exploitation of this potential is required to achieve long term goals of 50% airframe weight reduction and 50% cost reduction in future Air Force aircraft. Innovative structural airframe concepts for service temperatures less than 700oF, which focus on an engineered materials approach in conjunction with low-cost manufacturing methods, are required. Areas of ultralightweight/low-cost metallic and composite structural concepts and joining methods, highly robust composite structures for severe service usage having improved durability and impact resistance, and multifunctional smartskin structures approaches which incorporate embedded electronics for sensing or communications to achieve overall system weight savings. Concepts are required for both lightly loaded and heavily loaded airframe structural applications, covering vehicle classes from future fighters and High Altitude Long Endurance type platforms to retrofits on existing cargo and bomber aircraft. In the Phase I proposal, bidders should demonstrate a clear understanding and familiarity with the technical issues and should clearly explain the uniqueness of their approach.

Phase I: Will establish the technical feasibility of candidate innovative, low-cost, lightweight structural airframe concepts. Limited, small specimen mechanical testing should be performed to aid in assessing feasibility.

Phase II: Will scale up the approach to larger structural sections, generate mechanical property data, and perform testing to verify structural integrity under anticipated service conditions.

Phase III: Commercialization will exploit the structural developments achieved during Phase II for high payoff applications to all classes of military aircraft and advanced commercial and private aircraft.

AF93-125 TITLE: Fighter Cockpit Precision Cursor Control

CATEGORY: Basic Research

OBJECTIVE: Design and evaluate precise and rapid methods for cursor control in fighter cockpits.

DESCRIPTION: Future high definition cockpit displays have the potential of presenting more information in a given size of display space than in current cockpits. As a result, if a pilot is to provide control through a cursor on the screen, precise, as well as rapid positioning of the cursor in an information dense picture will be mandatory. Single pilot operation and limited cockpit space in a fighter make the problem of designing a control device more difficult than in a multicrew transport or bomber. The current method of controlling a cursor in a fighter cockpit using a pressure sensitive rate switch mounted on a throttle is inadequate. Rate (first-order) controllers require more time and attention to move to any desired position, and can be frustrating to place precisely compared to position (zero-order) controllers. The objective of this effort is to develop alternate control schemes and devices, and evaluate them in piloted simulation of fighter combat operations.

Phase I: Will include mission analysis, preliminary designs, and selection of concepts for Phase II development.

Phase II: Will include hardware and Ada software code development, and piloted simulation evaluations of the selected concepts.

Phase III: The integration of a concept into flight qualified hardware and software.

AF93-126 TITLE: Dynamics Displacement and Strain Measurements for Aircraft Tires

CATEGORY: Basic Research

OBJECTIVE: Develop equipment to measure aircraft tire surface strains and displacements during dynamometer tests.

DESCRIPTION: The Air Force need for "Extended Life/Reliable Tires" will be addressed by extending testing capabilities to include measuring tire surface strains and displacements during dynamometer testing. This capability will allow strain and displacement comparisons to be made between manufacturers, construction type, and operating conditions. There is no efficient way of measuring and quantifying tire strains and displacements during static and dynamic conditions. This capability is a significant technology breakthrough for designing and evaluating extended life tires which will enable the Air Force to achieve its goal of doubling current aircraft tire life. Annual Air Force savings if this goal is achieved is projected as $9 million per year

for the F-16 fleet.

Phase I: Will determine the applicability of such equipment using (Shadow Mooire, Shearographic, Holographic or Other) methods. The necessary requirements include that the system must not impede normal dynamometer operations, the system is desired to be remote (at least 10 ft from the dynamometer) and the dynamometer be 120 inches in diameter with a maximum tire rotational speed 80 Hz. The system should contain capabilities to store the test data to play back strain histories during the dynamometer test cycle. The system should allow graphical display of the tire with line contours and calibrated digitized data. Desired data to be extracted are the normal and tangential displacements and the three components of in plane strain. The system should allow a variable sensitivity level to analyze both high and low deflection conditions.

Phase II: Will require the contractor to manufacture the equipment and install the system on the Wright Laboratory's 120 inches south carriage dynamometer. Validation tests will be performed using static, high speed, cornering and braking conditions using a preselected Air Force Tire.

Phase III: Validated high-speed dynamic displacement/strain measurement systems could then be marketed by the small business to the tire industry.

AF93-127 TITLE: High Frequency Hypersonic Fluid Diagnostics

CATEGORY: Basic Research

OBJECTIVE: Develop innovative system to measure time-resolved thermodynamic or velocity fluctuations in hypersonic wind-tunnel flow.

DESCRIPTION: Time-histories of fluid fluctuations are required to understand the physics of turbulent or unsteady flows. Due to the high velocities and small dimensions of hypersonic wind tunnel shear flows, fluctuation frequencies reach several hundred kilohertz or even the megahertz range. The high frequencies and high temperatures associated with hypersonic flow place an extreme burden on measuring systems. The only systems currently used to measure hypersonic fluid fluctuations are constant-current hot wire anemometers, which suffer a number of drawbacks. The hot wires must be small in size to reduce their thermal capacitance and must be heated above wind tunnel stagnation temperatures. These factors make the probes extremely fragile and difficult to handle. Calibration and interpretation of the signal is difficult, and the probe output must be frequency compensated to correct for its finite thermal inertia. Optical diagnostics which rely on scattering from seed particles or air molecules are non-intrusive, but current systems are incapable of measuring at useful frequencies due to low photon capture rates. Some systems permit essentially instantaneous measurements, but the measurement repetition is too slow to obtain spectral resolution in frequency range of interest. An innovative measurement system is sought which would allow measurements at frequencies up to 1 megahertz, at Mach numbers up to 14, and at dynamic pressures up to 6 psi. The system may be intrusive or non-intrusive, and the output should be reducible to thermodynamic properties or velocity.

Phase I: Will analyze the proposed system and demonstrate its feasibility.

Phase II: The system will be installed and demonstrated at Wright Laboratory.

Phase III: The technology developed in the first two phases will be developed by the small business for marketing to the entire aerospace industry.

AF93-128 TITLE: Mission and Flight Control Simulation

CATEGORY: Basic Research

OBJECTIVE: Development of improved simulation methods for engineering development supports precision strike and air power projection.

DESCRIPTION: Develop one or more innovative methods for software or hardware that will create new or improve existing capabilities or reduce acquisition and maintenance costs for a) secure, long haul (many miles) simulation networks, including methods for reducing time delays and reducing long haul traffic without exceeding the maximum allowable delays for piloted simulations; b) flight simulator displays where the special interest areas are improving the brightness, contrast, resolution, field of view, and reducing geometric distortion as seen by the pilot, reducing the weight and improving the center of gravity for helmet mounted displays, development of multiple eye point display technologies, and multiline rate compatible displays; c) adding or improving dynamic distortion corrections for simulator displays that improve performance or reduce latency or costs; d) automated simulation threats or digital simulation players for force level simulations that can improve fidelity, improve tactics,

increase the number, reduce setup complexity or reduce latency of computer generated models.

AF93-129 TITLE: Thermal Energy Recovery and Management

CATEGORY: Basic Research

OBJECTIVE: Identify viable methods of recovering and utilizing wasted thermal energy generated by aircraft systems.

DESCRIPTION: All aircraft systems generate waste heat. Currently, this heat is dissipated without gaining any particular benefit. Ever decreasing DOD budgets demand that Air Force systems become more affordable. One possible way of achieving this goal is by the recycling of wasted thermal energy presently generated throughout our aircraft systems. We are interested in innovative methods of recovering and utilizing this energy to produce useful work. Emphasis should be on fighter type aircraft, but technology that is applicable to other aircraft types is desirable. The research should examine all available heat sources with regard to collection, recovery, and conversion into a useable energy source. Specific applications that could be powered by the recycled thermal energy may be considered, as well as the task of simply producing alternative energy sources such as electricity.

Phase I: Energy recycling concepts will be developed and conversion feasibility will be demonstrated.

Phase II: Build and demonstrate the performance of those concepts developed during Phase I.

Phase III: Validate a full scale energy recycling system.

AF93-130 TITLE: Active Flow Control Device Development

CATEGORY: Basic Research

OBJECTIVE: Improve the performance of military aircraft through the practical application of active flow control devices.

DESCRIPTION: Military aircraft of various types experience performance limitations due to encountering regions of separated flow at various flight conditions. These regions of detached flow can be precipitated by elevated aircraft angle-of-attack (wing stall), open cavities (weapon bays), nonaerodynamic shaped appendages (electronic countermeasure pods) and other means. Static flow control devices such as wing leading edge flaps and vortex generators have been used successfully to reduce regions of separated flow and increase aircraft performance in specific flight regimes. The development and application of practical active flow control devices offer the potential for far greater separated flow control over a wider range of flight conditions.

Phase I: Will include an experimental demonstration of an active flow control device that will improve military aircraft performance by controlling the aircraft flowfield in a practical way.

Phase II: Will include an active flow control device performance validation ground experiment under simulated flight airflow conditions.

Phase III: Shall flight demonstrate the active flow control device at full scale

AF93-131 TITLE: Facilitating Accident Evaluations of Aircraft with "Glass" Cockpits

CATEGORY: Basic Research

OBJECTIVE: Develop means for determining what the cockpit primary electronic displays were portraying immediately prior to accident.

DESCRIPTION: Despite the availability of crash data recorders and cockpit voice recorders, official investigations of aircraft accidents often also involve the examination of primary cockpit instruments. Heretofore, such instruments were of mechanical design. As such, they could offer positive clues of what the instruments were reading at the time of crash. . . that is, the position of jammed gears, heat imprints of dial indicators, etc. Future military cockpit instruments will be of electronic design (Cathode Ray Tubes, Flat Panel Displays, etc.) and will not be capable of providing accident investigators with such "a look" at what the pilot saw immediately prior to crash. A technique is now needed that will enable investigators to continue evaluating instrument readouts, as they appeared to the pilot, immediately prior to the accident. . .at least, to the extent that was possible with the past generation of mechanical instruments. Such "looks" need not replicate all the detail or resolution shown on the

primary electronic display instruments. Only that detail need be provided which will enable positive identification of the usefulness of the display instrument, and, positive identification as to the subject matter being portrayed. . .just prior to the accident. Such methods should obviously be able to resist the extreme environments (heat, shock, moisture, etc.) associated with crashes. Also, such techniques should have negligible or no negative impact on the reliability of the cockpit instruments. Small physical size, simplicity, and economical production should guide the design concept. The use of special ground support equipment, in conjunction with the newly developed airborne "devices," is an accepted fact. The concept being sought should not be based on use of the classical video camera.

Phase I: Will define and validate the concept via analytical methods. some validation via simple lab demonstrations is also desired.

Phase II: Will apply the acquired Phase I principles to actual hardware transition to a potential production prototype.

Phase III: Will deal with those fabrication aspects that focus on producibility of the associated hardware.

AF93-132 TITLE: Carbon-Carbon for Space Structures

CATEGORY: Exploratory Development

OBJECTIVE: Enhance state-of-the-art space carbon-carbon by lowering minimum gauge, improving test, and bonding methods.

DESCRIPTION: Future spacecraft will require advanced materials to save weight and maximize performance. Carbon-Carbon has extremely high specific properties, doesn't outgass, and is survivable (laser, nuclear). In order to be a viable material of choice for space, the state of the art must be advanced in the following areas: (a) Minimum Gauge. In order to minimize weight of the component, thin ply carbon-carbon is needed. Current state of the art is around 20 to 30 mils in the composite with ply thickness of 7 to 10 mils. Applications exist for multi-ply composites under 10 mils. (b) Test Methods. Thin walled (10 to 100 mil), high modulus (greater than 40Msi), complex shape composites present a unique testing challenge. Innovative test methodology is needed to enhance property determination. (c) Bonding Methods. For space structures, weight in the joint is in many cases the dominant portion of the structure weight. Improved carbonaceous bonding or brazing may decrease weight over that of a bolted design for either thermal or mechanical joints. (d) Laser Effects. The minimum heat treatment cycle needs to be determined for the range of carbon-carbon matrices in order to establish the most economical cycle that does not outgass under threat conditions. (e) Environmental Effects. Parametric studies need to be performed to determine how thin a coating must be (on a variety of different weave constructions and deposition techniques) to provide an effective barrier to atomic oxygen. Phase I will consist of parametric studies and model behavior with small coupon level articles produced and evaluated. For Phase II, R&D will continue for the most promising Phase I concepts. Phase III would further develop materials and processing capabilities such that a successful transition is made to industry through concurrent engineering between disciplines (designers, thermal and mechanical analytic modeling, materials manufacturers).

AF93-133 TITLE: Advanced Thermal Protection Materials

CATEGORY: Exploratory Development

OBJECTIVE: Investigate advanced thermal protection materials and associate technology.

DESCRIPTION: Advanced thermal protection materials are required for future ballistic and maneuvering reentry vehicle systems. Projected maneuvering reentry environmental trends, for example, include extended heating, heat soak-out effects, large structural loads, and terminal targeting. Phase I will investigate advanced materials and associate technology including innovative materials concepts, analytical/experimental techniques to assist in materials selection and potential performance assessment, and mechanistic studies on critical material/environmental interactions. Reentry vehicle components and elements include the nosetip, heatshield, leading edges, antenna window, control surfaces, interface joints, thermal insulation, structure, specialized surface treatments, boundary-layer, and trailing wakes. Phase I studies within this broad technical field must address key technical challenges for significant improvements over the current state of the art. Prior art (circa 1958 onward) will be considered in determining potential performance payoff or possible duplication of effort. Phase II will continue the R&D of promising materials and technological elements, with emphasis upon understanding the interrelationships between materials compositional variables and thermal protection performance. Phase III would develop a materials and processing capability for processing high performance materials for flight test (or equivalent ground test) demonstration. (This topic does not address compiled materials property/performance databases, film/transpirational cooling, manned reentry vehicle systems, refractory

ceramic composites, or reusable thermal protection materials.)

AF93-134 TITLE: New High Performance Polymers for Opto-Electronics

CATEGORY: Exploratory Development

OBJECTIVE: Investigations are sought to discover new polymeric materials with potential for the development of improved opto-electronic materials.

DESCRIPTION: Investigate the synthesis, theory, processing, and properties of new polymers to provide performance advantages over state-of-the-art materials. Polymer systems with exceptionally high nonlinear optical coefficients, optical transparency, or intrinsic conductivity and reasonably low processing requirements are of primary interest. Areas of emphasis include investigations of (a) theoretical and synthetic chemistry to provide fundamental understanding of the molecular requirements for achieving nonlinear optical or intrinsically conductive properties and optical transparency in organic and semiorganic polymer systems, (b) processing and morphology of polymers to discover approaches for achieving superior nonlinear optical coefficients, intrinsic conductivity, and optical transparency, (c) polymer structure-property correlations to elucidate processing options for achieving desired morphologies as well as opto-electronic, optical, and electrical properties, (d) novel composite materials or material configurations to advantageously use multifunctional properties of polymers such as photoconductivity, photorefraction, light emission and light detection. The establishment of viable approaches to obtaining improved nonmetallic materials are sought in Phase I efforts which can be pursued in Phase II follow-on efforts to screen and further develop the new high performance polymers to optimize their opto-electronic properties and processability. Phase III would determine the data necessary to successfully transition this technology to industry including factors of scale-up, cost, and devise applications.

AF93-135 TITLE: Optical Signature Control Materials

CATEGORY: Exploratory Development

OBJECTIVE: Develop new and improved materials for controlling the optical signatures of aircraft.

DESCRIPTION: The Air Force is interested in conducting research into the science of understanding and controlling the optical signature of aircraft with emphasis on the infrared region. Specifically, research shall involve controlling emissivity/reflectivity in the ultraviolet, visible, and infrared regions of the electromagnetic spectrum. Investigations may include bulk materials properties and/or novel concepts based on combinations of constituent materials in some unique construction. Phase I will address application requirements and goals as well as initial formulation, fabrication, and evaluation of specific subjects for proof of concept. Phase II will further develop and optimize the material(s) techniques, and produce larger samples for a full spectrum of evaluations. Phase III would scale up the production capability and produce the material in sufficient quantities to be used on military aircraft.

AF93-136 TITLE: Advanced Aerospace Metallic Composites

CATEGORY: Exploratory Development

OBJECTIVE: Develop improved metallic composites based on alloys of Aluminum, Titanium, or ordered intermetallic compounds.

DESCRIPTION: Unique approaches to the development and processing of advanced metallic composites are needed to achieve the goals of major Air Force initiatives such as National Aero-Space Plane and Integrated High Performance Turbine Engine Technology. Composites based on alloys of Titanium, ordered aluminide compounds, and other intermetallic compounds provide significant potential for increased operating temperatures and decreased density. Novel approaches utilizing continuous and/or discontinuous reinforcements in a continuous matrix are of interest, as well as more recent approaches, including ductile phase toughening, intermetallic eutectic alloys, and laminated composites. Novel concepts for composite processing leading to i nproved compositional, microstructural, and interface control (such as vapor processing) are sought. The basis for anticipated

benefits must be clearly established prior to Phase I activity. Phase I of the program must address materials requirements and goals for relevant aerospace applications, and develop proof of concept through mechanical property determinations or other relevant tests.

Phase II will optimize chemistry, processing, and microstructure, and produce larger amounts of material for a full spectrum of mechanical property evaluation. Phase II will also include a preliminary evaluation of trade and design studies to give an early indication of future application potential. Phase III would pursue composite development activities aimed at specific aerospace components.

AF93-137 TITLE: High-Temperature Structural Materials for Advanced Air Force Systems

CATEGORY: Exploratory Development

OBJECTIVE: Develop and characterize advanced high temperature structural materials

DESCRIPTION: New approaches are requested to develop and characterize (a) advanced high temperature structural ceramic composites (2500F to 4000F, excluding carbon-carbon composites), (b) intermetallic materials and composites (2000F to 3000F, excluding nickel aluminides and titanium aluminides), and (c) model forming process for advanced structural materials. For ceramic composites, research is limited to continuous ceramic fiber reinforced ceramic matrix systems and may include the following: (a) new, unique ceramic composite development; (b) fiber/matrix interface treatments engineered for toughened behavior and stability; (c) continuous ceramic fiber development; (d) test techniques to determine mechanical and physical behavior (such as failure modes, crack and void growth, oxidation, stress-strain, cyclic stress-strain etc.) as a function of temperature and loading history; and (e) analytical modeling of composite behavior. For intermetallic materials, research is limited to (a) new or novel methods for synthesis and processing of composites from intermetallic alloys which emphasize achieving theoretical density, low defect and interstitial content, and low synthesis temperatures; (b) methods for modeling intermetallics and intermetallic composites which lend insight into chemistry selection and control as well as microstructural selection and control (c) methods of fabricating composites to provide chemistry and microstructural control on a submicron scale while maintaining the ability to vary and control the final microstructural scale; and (d) methods for environmental protection of intermetallic composites aimed at providing long life under cyclic oxidation conditions. For modeling of forming processes, research may include modeling of (a) the unit forming process, (b) the material behavior in response to the demands of the unit process, (c) the interface between the work piece and the die of mold, and (d) novel methods for obtaining physical property data and constitutive equations for insertion into models. Phase I will focus on the critical issues which, when solved, will provide proof of concept. Phase II will be structured to develop and refine those feasible concepts to the point where an assessment could be made of the ultimate potential to help meet Air Force advanced materials needs. Phase III would pursue material development effort aimed at specific aerospace components.

AF93-138 TITLE: Improved Nondestructive Evaluation

CATEGORY: Exploratory Development

OBJECTIVE: Development of new, nondestructive, evaluation techniques for advanced aerospace applications.

DESCRIPTION: Advanced, innovative approaches are needed for the development of new and improved nondestructive inspection and evaluation techniques for the detection, imaging and characterization of flaws and other integrity-reducing anomalies in flight vehicle and engine materials including metals, and metal and non metal matrix composites. Improved techniques are also needed for real-time monitoring of the manufacturing processes used to fabricate aerospace components from these materials. In particular, innovative technical approaches are needed for (a) the detection, imaging and characterization of bulk and surface anomalies both metallic and nonmetallic structures, (b) the evaluation of the integrity of bondliness in structures containing adhesive and metal-metal bonds, (c) the determination of the condition of matrix and reinforcing substructures in advanced composite structures, (d) establishing the quality of high-temperature material coatings, (e) the inspection and evaluation of electronic device materials and components, (f) the quantitative characterization of materials properties, and (g) detection and characterization of corrosion in hidden/nonaccessible locations before significant material loss has occurred. Technical approaches proposed must either achieve clearly significant
improvements in the standard techniques currently being used in factory and field inspections, or must identify new inspection and evaluation technologies which have capabilities far superior to those currently used and which have the clear potential for

ultimate use in realistic manufacturing or in-service environments. Phase I of this program would address the initial formulation, fabrication, and evaluation of specific NDE techniques for demonstration of proof of concept. Phase II will perform enhanced development for optimization of the techniques investigated in Phase I. Phase III would, as appropriate, perform the remaining development required to bring the technique or equipment of a marketable state.

AF93-139 TITLE: Biotechnology for Nanostructures, Electronic, and Optical Applications

CATEGORY: Exploratory Development

OBJECTIVE: Apply biotechnology to obtain novel processes or materials to solve AF problems.

DESCRIPTION: The Air Force is interested in research and development projects directed toward potential applications of biotechnology to aerospace requirements. Such programs should address the fabrication of materials with compositions and/or microstructural morphologies of such complexity that they are only obtainable through natural processes. The study of this area could conceivably lead to the development of lower energy processing and materials with very specific electronic and electro-optical properties and contain very few microstructural anomalies. Since biological materials often perform several functions with ease, an investigation of the trade-offs involved in natural material systems could lead to a design philosophy for multifunctional materials with, for example, both electro-optical and structural properties. In a Phase I, programs in these areas should address the requirements and goals of the proposed efforts, as well as initial formulation, fabrication, and evaluation required for proof of concept. In Phase II, the process or design concepts from Phase I would be developed through optimization and scale-up efforts to establish feasibility for manufacture. Either process or design concepts would lead to a marketable product after a Phase III program.

AF93-140 TITLE: Nonlinear Optical Materials

CATEGORY: Exploratory Development

OBJECTIVE: Develop nonlinear optical materials with superior properties as compared to those presently available.

DESCRIPTION: Nonlinear optical materials are required for a variety of potential Air Force applications including optical signal processing (switches, modulators, and guided wave devices) and new laser sources (optical parametric oscillators and harmonic generators). However, presently available materials are unsatisfactory for many applications due to small nonlinearities, poor optical clarity, long response times, difficulty in processing for devices, and other factors. Proposed efforts must address material issues for either inorganic or organic materials in either bulk or thin film forms. Innovative techniques for preparing new materials are encouraged. Nonlinear optical devices may be examined only for the purpose of evaluating and demonstrating the properties of the material(s) as a minor part of a materials effort. Phase I of this program will demonstrate the proposed growth or processing techniques. Phase II will develop advanced nonlinear materials and relevant processes to demonstrate potential. In Phase III, advanced nonlinear optical materials would be optimized for specific applications.

AF93-141 TITLE: Advanced Semiconducting Materials

CATEGORY: Exploratory Development

OBJECTIVE: Develop advanced wide band gap semiconducting materials and improved processes for the growth of these materials.

DESCRIPTION: Advanced Air Force systems will require new and novel semiconducting materials to meet challenging power, frequency, speed, and temperature requirements. Conventional semiconductors such as bulk silicon and gallium arsenide cannot meet these requirements. Materials systems of interest are silicon carbide and III-V nitrides. Both bulk and epitaxial material are of interest, as well as heterostructures and superlattices, as well as alloys or heterostructures of III-V's with group IV elements, compounds and alloys. Growth of these new materials requires the development of improved techniques for epitaxial and bulk growth. The offeror is reminded that this is a materials task and projects that are primarily device development or device processing will be considered nonresponsive. Phase I will address process development and initial testing to show proof

of concept. Phase II will develop the advanced semiconducting material or process to demonstrate the potential application. Modeling studies of the growth process or materials properties are appropriate for Phase I or as a part of Phase II. Deliverables of test materials to the government for testing are encouraged. In Phase III the advanced semiconducting material or process would be optimized for specific applications.

AF93-142 TITLE: High Temperature Superconducting Materials

CATEGORY: Exploratory Development

OBJECTIVE: Develop processes for fabricating high temperature superconducting thin film junctions for electronic and opto-electronic applications.

DESCRIPTION: High temperature superconducting (HTS) materials offer a variety of application opportunities. For example, detection of infrared (IR) radiation can potentially be improved by increasing sensitivity, operating temperature, and signal processing speed over present technology. The properties of the materials and interfaces must be controlled, and detection techniques must be evaluated in order to fully assess the value of HTS technology. Development of unique thin film deposition and processing methods for fabrication of junctions or hybridization with other electronic technologies, investigation of the superconducting/nonsuperconducting material interface, and measurement of the opto-electronic response of films and junctions are examples of subjects considered appropriate for this program area. This topic addresses the development of thin film processing techniques, particularly for fabrication of SNS and possibly SIS junctions, and the characterization of opto-electronic properties. Device development will not be supported. Phase I will address application requirements and goals as well as initial formulation, fabrication, and evaluation of specific subjects for proof of concept. Phase II will perform enhanced development for optimization. In Phase III, HTS materials would be optimized for specific applications such as infrared detection and digital processing.

AF93-143 TITLE: Biodegradable Plastic Media Blast (PMB) Materials

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate feasibility of biodegradable abrasive media for use in stripping paint from aircraft structures/components.

DESCRIPTION: State-of-the-art PMB materials are either conventional thermoset or thermoplastic materials and are not easy to dispose of after use. Biodegradable plastic media needs to be developed that can be utilized in conventional PMB equipment, resulting in removal rates equal to the conventional PMB materials. This new biodegradable PMB material should be easily and rapidly digested or degraded by biotechnology processes to environmentally acceptable waste stream products. Phase I goal is to demonstrate feasibility of development of readily biodegradable plastic abrasive media that affords strip rates competitive with those materials currently in use. Phase II is to optimize material for degradability and strip rate. Evaluate effects on substrate mechanical properties and repaintability. Set up tests to determine equipment operating parameters. A full-scale demo on operational equipment and on operational aircraft - establish M&P specifications and finalize on process controls and parameter setting would be the goal for the Phase III effort.

AF93-144 TITLE: Sol-Gel Deposition of Coatings on Aluminum Alloys

CATEGORY: Exploratory Development

OBJECTIVE: To demonstrate sol-gel deposition of ceramic coatings on aluminum alloys as pretreatments for adhesive bonding.

DESCRIPTION: State-of-the-art processes for pretreatment of aluminum alloys for adhesive bonding or for corrosion protection involve chemically grown, hydrated oxides (anodizing) and the use of chromated corrosion inhibitors. These processes are large water users, and the chromates are toxic and hazardous. Research has shown that ceramic inorganic coatings have the necessary thickness, strength, adhesion, and morphology to function as adhesive bonding on corrosion protection layers. These coatings may be deposited in a controllable manner via nonchemical means such as low temperature, low pressure chemical vapor

deposition, laser assisted pyrolitic decomposition, plasma-enhanced deposition processes, and sol-gel processes. The chemical layers so formed would be anhydrous, not subject to the temperature limitations of state-of-the-art coatings and would be formed via environmentally acceptable processes. The Phase I goal is to demonstrate process feasibility. Inorganic, anhydrous coatings shall be deposited on aircraft grade structural aluminum alloys using the sol-gel process. The coatings shall be characterized as to chemical composition, morphology, thermodynamic stability, hydrolytic stability, corrosion resistance and bondability. Coating influence on metallic alloy properties such as fatigue effects, shall be evaluated. Demonstrate the feasibility of using environmentally acceptable nonwater using process for pretreatment of aerospace structural aluminum alloys. Phase II goal is to optimize coating characteristics (thickness, density, adhesion, etc.) and process parameters to obtain best balance of adhesive bonding and corrosion resistance in bonded joints. Phase III would scale up and transition/transfer process to Air Force Logistics Centers, and industrial partners write specifications and standards and develop required data base.

AF93-145 TITLE: Optically Clear Canopy Repair Adhesive

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate use of optically clear, UV cure adhesives for rapid repair of damage to plastic canopies.

DESCRIPTION: State-of-the-art rapid repair for plastic canopies involves the use of sealants, metal plates, and metallic fasteners. The repairs are complex and obstruct the view of the pilot because they are opaque. R&D has shown that UV curing adhesives can be used to effect rapid, simple, and clean repairs to damaged plastic canopies. These adhesives are not optically clear nor are they formulated for the specific repair task of interest. Work is needed to develop optically clear, UV curing adhesives formulated for the rapid repair of plastic canopies. Phase I goal is to demonstrate the feasibility of making transparent, structural, battle damage repairs to plastic canopies and windscreens. Phase II is to develop materials (kits) and process for field level test and evaluation. Generate materials and process specifications and the necessary data base to support the application. Phase III would transition to AFLC and advanced battle damage repair teams. Add repair to battle damage technical order. Kits stock listed.

AF93-146 TITLE: More-Electric Aircraft Power System Technologies

CATEGORY: Basic Research

OBJECTIVE: Explore and develop electrical components and devices applicable to future and retrofit "more-electric" aircraft.

DESCRIPTION: Proposals should address one or more of the following: (a) 270 Vdc electric bus components; including batteries, motors, and generators; (b) fault-tolerant power control devices and arc detection and suppression schemes, including photonics; (c) source to load dynamic models, including load and fault transients; (d) lightweight electrical and mechanical energy conversion devices; (e) electromagnetic interference/electromagnetic compatibility (EMI/EMC) mitigation schemes; (f) integrated thermal control of power system elements; and (g) 10-30 MPa pneumatic storage/compressor technology. Phase I goals include analyses and proof-of-concept experiments. Phase II goals include detailed analytical derivations and prototypical device and/or hardware demonstrations. Phase III goals include demonstrating flight-qualified, flight-ready hardware.

AF93-147 TITLE: Power Electronics

CATEGORY: Basic Research

OBJECTIVE: Explore and develop power electronics devices for future 1kW-150kW aerospace power system applications.

DESCRIPTION: Proposals should address one or more of the following: (a) power control and conditioning technologies; (b) advanced inverter topologies; (c) high temperature (200 degree C or greater) power active and passive devices; (d) high frequency (75 kHz and above) conversion low loss techniques; (e) high frequency low loss (75 kHz and above) magnetics and capacitors; and (f) high heat flux thermal control techniques and integral lightweight structures and packaging. Phase I goals include analyses and proof-of-concept experiments. Phase II goals include detailed analytical derivations and prototypical device and/or hardware demonstrations. Phase III goals include demonstrating flight-qualified flight-ready hardware.

AF93-148 TITLE: Advanced Energy Conversion

CATEGORY: Basic Research

OBJECTIVE: Characterization and application of advanced energy conversion materials.

DESCRIPTION: Proposals should address (a) semiconductor; (b) capacitor; (c) magnetic; (d) superconducting; (e) dielectric; (f) heat transfer and working fluids; (g) refractory; (h) electrochemistry; and (i) composite materials applicable to aerospace power system applications. Phase I will focus on characterization of properties of these materials as related to envisioned applications and quantitative assessment of realizable benefits/improvements to system/subsystem performance. Phase II goals will focus on improvements to properties, batch manufacturing methods, and demonstration of the material in a prototypical configuration or embodiment. Phase III is expected to transition the Phase II products to a specific application via design, resolution of unresolved production and manufacturing issues, and/or complete demonstration of material compatibility, life, and/or properties for a specific application.

AF93-149 TITLE: Physics of Plasma Processing

CATEGORY: Basic Research

OBJECTIVE: Explore and characterize the plasma physics fundamentals governing interfaces produced by plasma-enhanced deposition.

DESCRIPTION: Proposals should address plasma processing and plasma-enhanced deposition science related to (a) semiconductors/contacts and (b) dielectric (e.g., diamond) films on conductors, semiconductors, and refractories. Phase I efforts will focus on identifying physical mechanisms and limitations governing important interfaces and their processing parameters (e.g., uniformity, topography, rates of deposition, defects) related to the plasma, surface interaction problems. Phase II efforts will focus on demonstrating process control and validating improvements. Phase III efforts will demonstrate specific device applications of the improved plasma processing.

AF93-150 TITLE: Arbitrary Grid Patching for 3-Dimensional Compressible Flow Simulations

CATEGORY: Basic Research

OBJECTIVE: Develop and demonstrate methodology for transfer of data between computational zones with arbitrary grid alignments.

DESCRIPTION: In order to design/evaluate advanced airbreathing propulsion components and systems, computational fluid dynamics (CFC) techniques are being used. However, due to the complex geometries being considered, grid generation has become a major difficulty. For analyzing complex geometries with advanced CFD codes, grid generation is complicated by the requirements for a single zone grid. Some advanced CFD codes have grid blocking where a single grid can be split into multiple sections; however, the grid lines must continuously pass through the block boundaries. Other CFD codes have arbitrary zone interfacing; however, the interfacing is rarely done in a conservative manner making the results suspect. Phase I is to demonstrate a practical, accurate, and conservative zone data transfer methodology applicable to full Navier-Stokes flow simulations. The method should be applicable to overlapping and nonoverlapping 3-dimensional grids, as well as steady-state or time-dependent simulations. The transfer of conservation, primitive, and characteristic variables should be considered. Phase II is to incorporate the developed methodology into a CFD code that has been well calibrated for internal, high-speed flows with finite rate chemistry. It is also desirable, but not required, that this code already be in use by the Air Force for these problems. During Phase III the contractor shall deliver and demonstrate the code to the Air Force including installation on a designated computer, complete software listings, code operating instructions, and a training class.

AF93-151 TITLE: High Mach Combined Cycle Engine Technologies

CATEGORY: Basic Research

OBJECTIVE: Develop key technologies for combined cycle engines operating from Mach 0 to 6 flight speeds.

DESCRIPTION: Investigations of combined cycle propulsion systems have shown turboramjets and air-turborockets to be very attractive propulsion concepts at Mach 0 to 6 flight speeds. Both concepts combine the flexibility and efficiency of turbomachinery at flight speeds Mach 0 to 4 with the simplicity, low weight and high specific impulse of the ramjet in the Mach 3 to 6 flight range. Currently, plans are underway to develop technologies for both a turboramjet and an air turborocket under the High Mach Turbine Engine Technologies (HiMATE) program. Under this program, technologies which would be applicable to either cycle are of primary interest. The proposal must demonstrate an understanding of the HiMATE program and its goals. Examples of technologies which are of interest include air intake systems, exit nozzles, solutions to reduce the length and weight of the inlet and nozzle components, ramburner structures, ramburner fuel injection/flameholding schemes, endothermic fuel reactor/engine integration, heat exchangers using either fuel or a nonexpendable fluid to cool air, ramburner cooling techniques and air driven power generation devices. Proof of concept testing is preferred, but analytical investigations will also be considered. The goals of Phase I will be to identify a novel concept, quantify its payoff, and conduct a small-scale experiment to demonstrate concept feasibility. If a strictly analytical approach is proposed, sufficient analysis must be performed to demonstrate some degree of concept feasibility and plan experiments for Phase II. Larger scale development would be undertaken in Phase II. The proposal should include plans for Phase II testing which include identification of appropriate facilities. The goals of Phase III would be to integrate the components developed in Phase II into a combined cycle engine demonstrator and evaluate its performance.

AF93-152 TITLE: Diagnostic Measurements of Supersonic Flow Fields

CATEGORY: Basic Research

OBJECTIVE: Develop analytical techniques for mapping scramjet flow fields based on fuel penetration and mixing experiments.

DESCRIPTION: Obtaining accurate measurements of the various flow parameters - velocity, temperature, density (or pressure), and species concentrations - in a scramjet test-cell environment, without disturbing that which is measured, is a formidable task. Flow field mapping is important to the understanding of fuel penetration, mixing, and combustion, and provides a data base for the validation of computional fluid dynamics (CFD) models. Measurements of recombination in the exhaust nozzle, and of skin friction and heat transfer on all surfaces likewise will further understanding of supersonic combustion. Electronic processing of the instrumentation signals is an integral part of any mapping technique. The goal of the Phase I program will be to demonstrate the feasibility of the measurement method in a shock tunnel or blow-down tunnel. In Phase II, the contractor will develop the concept so that it can be used in a production mode in a test cell. It must tolerate high temperatures, high levels of vibration, and extended periods of continuous operation while requiring a minimum of recalibration and maintenance. A complete operating system, to be utilized in a supersonic flow test facility, would be a deliverable item. Phase III would see the concept applied to scramjet combustor development programs.

AF93-153 TITLE: Innovative Structural Concepts for Turbine Engine Components

CATEGORY: Basic Research

OBJECTIVE: Develop structural concepts for advanced material systems, including composites, for turbine engine component applications.

DESCRIPTION: The demands for improved performance in future gas turbine engines will require the use of advanced material systems, such as Metal Matrix Composites, Ceramic Matrix Composites, and Intermetallic Materials. These material systems have very different properties and characteristics from conventional materials; for example, fiber-reinforced composites exhibit strong anisotropy and fiber/matrix interactions. Experience has shown that a simple material substitution approach is an inefficient design method and that new approaches are needed to exploit advanced materials. Phase I will explore the feasibility of a new concept or concepts, through analysis or small-scale testing to demonstrate the potential merits of the concept. Further development under a Phase II effort should lead to the full demonstration of the concept, allowing it to be applied to engine components in Phase III.

AF93-154 TITLE: Neural Network Technology for Jet Engines

CATEGORY: Basic Research

OBJECTIVE: Design and evaluate neural network models for robust, fault tolerant, turbine engine controls applications.

DESCRIPTION: Future aircraft and turbine engine controls will be more robust, require higher levels of fault tolerance, and have reduced life cycle cost. Currently, fault tolerance is achieved by multiple levels of hardware and software redundancy, in addition to separate diagnostic systems to diagnose hardware and software faults. These systems impose a significant cost and weight penalty on the control system. Advances in neural network technology make feasible the development of significantly more robust control models, with inherent fault tolerance. Candidate neural network models should address one or more of the following technology areas: engine vibration monitoring, robust control, sensor/actuator fault detection, and control system fault tolerance. The goal of Phase I is to investigate neural network models applied to one or more of the turbine engine control technology areas. The results should demonstrate the applicability of neural networks for advanced turbine engine controls in terms of performance and development cost reduction. A detailed design, fabrication, and test of a prototype neural network controller shall be conducted in Phase II. An engine demonstration test of flight worthy hardware will be conducted in Phase III.

AF93-155 TITLE: Detection of Contamination in Synthetic Lubricants Prior to Reclamation

CATEGORY: Basic Research

OBJECTIVE: Develop methodology for on-site detection of contaminated materials that limit reclamation of synthetic turbine engine lubricants.

DESCRIPTION: Typically, used synthetic turbine engine lubricants are collected on-site then sold to contractors at relatively low prices for use as plasticizer. The potential for contamination of the gathered lubricants with other products, especially those that contain halogenated products, prevents use of a previously developed reclamation process. That process was successfully developed during the 1980's; however, it was not cost-competitive compared to purchase of new lubricants, due in part to the problem of contamination. Hence, technology that could effectively detect contaminants on-site by nontechnical personnel would significantly increase the potential for reclamation. Due to increasing environmental concerns associated with the use and disposal of lubricants and associated products, reclamation may not only be viable, but the preferred method for managing disposition of those materials. This Phase I effort will identify on-site monitoring technology to detect contamination of synthetic lubricants and determine the feasibility of developing the required technology. The Phase II effort will develop and demonstrate the required technology. Phase III would consist of commercialization of the on-site contaminant monitoring technology for use in a wide variety of applications.

AF93-156 TITLE: Advanced Digital Control Methodologies for Turbine Engine Magnetic Bearings

CATEGORY: Basic Research

OBJECTIVE: Develop advanced digital control methodologies and reduced controller hardware size for turbine engine magnetic bearings.

DESCRIPTION: Active magnetic bearings represent an innovative approach to aircraft engine rotor support with the potential of providing significant benefits not possible with conventional rolling element bearings. The successful application of active magnetic bearings would result in engines with no oiling systems, higher rotor speeds, reduced blade tip and seal clearances, reduced weight, and enhanced rotor dynamic control. However, advanced digital controls technology has been identified as a critical area for successfully achieving an operational aircraft engine magnetic bearing system. The digital controller must be able to reliably accommodate and control engine rotor dynamic behavior and thrust loading throughout the entire engine operating range while maintaining low power consumption, fault-tolerance, and compact size/weight. Phase I goals will include the design and analysis of an advanced active magnetic bearing digital controller that incorporates innovative control methodology techniques, increased reliability, and miniaturization. Issues such as system architecture, component technology, circuit configuration, power efficiency, and stability margin will be explored. The controller will be designed for a large

(approximately 30,000-lb thrust) man-rated, advanced, turbojet engine. Phase II activities would include the detailed design, fabrication, and testing of the selected controller configuration on a full-scale magnetic bearing rotor support system. Phase III goals would be to apply the controller concept to turbine engine magnetic bearing systems or demonstrator engines.

AF93-157 TITLE: Indicating Additive for Underground Fuel Spills

CATEGORY: Basic Research

OBJECTIVE: Develop an indicating additive for aviation turbine fuels to identify underground fuel spill.

DESCRIPTION: As underground fuel storage tanks age, the likelihood of underground fuel spills increases. If not detected rapidly, underground fuel spills can contaminate the ground surrounding the fuel tank and potentially enter the groundwater. In some locations, several different fuels may be stored (i.e., jet fuel, gasoline, diesel) in a single tank farm increasing the difficulty of determining which tank is leaking. Phase I of this program will be to identify and test the feasibility of an additive for aviation turbine fuel (JP-8) that can be used to detect a leak quickly and easily. The additive shall be compatible with all existing fuel system materials and must not alter fuel performance requirements. In addition, the additive shall be nontoxic and not become a hazardous material in the environment. Phase II of this effort will be to test the additive for compatibility of fuel system materials and demonstrate the performance of the material in a field situation. Toxicity testing will be conducted as required. Phase III of this effort will be to market the additive to government agencies and potential commercial users such as commercial airlines and fuel distribution companies.

AF93-158 TITLE: New Concepts and Innovations for Aeronautical Systems/Subsystems

CATEGORY: Basic Research

OBJECTIVE: Develop new concept and innovations for aeronautical systems/subsystems for possible emerging systems and update of existing systems.

DESCRIPTION: This category of innovative concepts is intended to cover all facets of aeronautical systems/subsystems research, development, and acquisition. It is intended to provide latitude to the innovator to include areas not specifically addressed by other specific aeronautical topics. This general area covers the full spectrum of Air Force aeronautical missions (i.e., tactical, airlift, mobility, strategic, transatmospheric, tactical relocatable targets, etc). Emphasis is placed on potential long term planning concepts. Topics as diverse as new weapon system concepts and improved operational techniques con be submitted. Innovations in technologies that are currently available only from foreign sources or from limited sources in the United States are specifically encouraged. Additionally, innovation proposals which address Logistic Technology Needs are encouraged. Some other areas of interest are high energy fuels, maintenance free systems, and innovative R&D organizational concepts. This topic is structured to provide a maximum of innovative flexibility to prospective participants. Therefore, in the Phase I proposal briefly address the anticipated phase II effort and potential for Phase III.

AF93-159 TITLE: Innovative Tools for Hypersonic Systems Planning

CATEGORY: Basic Research

OBJECTIVE: Develop planning tools for efficient development planning future hypersonic system.

DESCRIPTION: Fosters the development of innovative and effective design, modeling, systems engineering, mission analysis, mission effectiveness, cost estimating, schedule planning, supportability analysis, mission planning, risk assessment and technology assessment tools for Air Force development planners of future hypersonic systems. Future hypersonic systems include exoatomaspheric/endoatmospheric aero-space vehicle for space support and military poser projection, supersonic civil/military transport aircraft, mach 6-8 airbreathing hydrocarbon-fueled aircraft, mach 10-12 hydrogen fueled airbreathing aircraft, mach 15-20 boost-glide vehicle weapon, and mach 6-8 cruise missile. Innovation testing concepts and methodologies for test facilities and test capabilities for Air Force and national laboratories and test centers are also desired. As this is a very broad topic, in the Phase I proposal briefly address the anticipated Phase II effort and potential for Phase III.

AF93-160 TITLE: More Supportable T-38A as a Bomber Fighter Training System Platform

CATEGORY: Basic Research

OBJECTIVE: To determine solutions for streamlining flight line maintenance to increase T-38A utilization rates.

DESCRIPTION: The change in Air Force pilot training to a dual-track (Bomber/Fighter vs. Tanker/Transport) program, coupled with system modifications performed by the Pacer Classic program, will extend the life of the T-38A until 2017. Research is required to investigate potential solutions for decreasing the time required to service the aircraft between training sorties. This would increase aircraft utilization rates and improve "surge" capability. Phase I activity would establish a baseline by reviewing present aircraft servicing procedures and whether anticipated future force structure decisions (base closing, changes in rate of pilot training production, aircraft attrition) will drive requirements that warrant procedural or system changes to T-38A maintenance procedures. Phase II activity would identify specific procedural process improvements and aircraft system upgrades/modifications that would significantly decrease the time required between aircraft sorties for servicing. Thus, this research will identify potential Logistics Requirements for Technology. Phase III should involve prototyping of selected Phase I upgrade(s)/modification(s) to the T-38A aircraft.

AF93-161 TITLE: Development of a Decision Support Tool for Development Planning

CATEGORY: Basic Research

OBJECTIVE: Develop and demonstrate the application of an automated decision support tool for long-range acquisition planning.

DESCRIPTION: An automated decision support tool is needed, in Premilestone I Acquisition activities, to assess and prioritize system concept alternatives and supporting technologies based on military operational requirements. This computer-based system must be consistent with the strategies-to-task process. As a minimum, the elements: 1) military mission, 2) military operational requirements, 3) system concept alternatives, 4) functional capabilities of the concepts; and 5) supporting technologies. The automated tool will allow the user to establish priorities and assign a relative importance at any level of the strategies-to-task hierarchy. The system will be capable of maintaining an audit trail of user inputs and system generated output and allow easy retrieval of that information. As a minimum, the output from the decision tool is a rank ordering of system concepts and technologies and an assessment report. The user will be able to conduct sensitivity analyses and query the system to trace a technology linkage back to a specific user requirement or a set of requirements and determine why one technology ranks higher than another. The contractor will examine at least two feasible analytical approaches, such as Quality Function Deployment (QFD), for developing the system, and recommend the most desirable, and give the rationale for their recommendation. The structure of each approach should be generically applicable to any Air Force mission area. The contractor will develop the decision support tool and associated documentation and demonstrate the system. The phase I deliverable will be a working prototype system with source code and user's manual. Additionally, the contractor will provide a study report that verifies that the system is based on sound analytical methods and demonstrate the application with a realistic example. At the end of Phase II the contractor will deliver a completed and fully tested computer-based system, source code, user's manual, and programmer analyst manual. The contractor will perform a full demonstration of the system for the mobility mission area. Phase III should involve the marketing of this Development Planning Tool as a standardized long-range acquisition planning tool within the DoD.

AF93-162 TITLE: Aerial Refueling Communication Under Radio Silent Conditions

CATEGORY: Basic Research

OBJECTIVE: Develop system design approaches to provide radio silent conditions during aerial refueling procedures between tanker/receiver aircraft.

DESCRIPTION: Currently, when the taker boom is inserted into the receiver receptacle, through-the-boom communication is established between KC-135/KC-10 tanker aircraft and the receptacle equipped receiver aircraft. Prior to boom-receptacle contact, during radio silent conditions, communications between aircraft is accomplished through the use of aircraft lights.

Similar limitations also exist during the entire aerial refueling sequence when using probe-drogue systems.

A system which could provide verbal communications during all phases of aerial refueling, while not compromising radio silent conditions, is required to eliminate these operational problems. The system should operate at tanker/receiver distances of 3/4 -1 mile apart before tanker/receiver hookup, and be capable of communication to each receiver aircraft refueling off the tanker's aerial refueling boom and/or wing probe-drogue system(s) position. The communication system must be compatible with single seat receiver aircraft. During Phase I it is requested that candidate communication systems be analyzed and one or two potential candidate systems be selected for continuation into Phase II. In Phase II, the contractor would design, develop, and provide a flightworthy prototype system for the tanker and receiver aircraft. Phase III would involve a flight test and service test on the prototype system followed by limited/full production.

AF93-163 TITLE: Wear/Vibration Criteria for Fasteners

CATEGORY: Basic Research

OBJECTIVE: Investigate wear/vibration criteria for fasteners to develop prediction models for depot service

DESCRIPTION: Fasteners of various types are used extensively in several applications over the entire aircraft. With the passage of time, some of the fasteners tend to "lose their grip" especially when used in thin sheet applications. It is not clearly understood whether this phenomenon is due to wear of the components being fastened, wear on the fasteners, their location, relative hardness of the fasteners with respect to the material being fastened, operational loads, galvanic action because of dissimilar metallurgy of a combination of some or all of the above factors. This SBIR will select a fighter aircraft (e.g. F-15) and identify the different types of fasteners, location, metallurgy, operational loads, typical duty cycles and vibrational frequencies. It will then be determined which fasteners are more prone to lose their grip and a prediction model will be developed to determine when the aircraft would be scheduled for service checks. In Phase II, the contractor shall investigate in detail problems with these fasteners and develop a prediction technique/model for determining service live. In Phase III, the contractor shall verify these models against field data.

AF93-164 TITLE: Armament Research

CATEGORY: Exploratory Development

OBJECTIVE: Develop innovative concepts in areas associated with air deliverable munitions and armaments.

DESCRIPTION: New and innovative ideas/concepts and analysis methodologies are desired in the area of air delivered non-nuclear munitions and armaments. These include bombs, submunitions, warheads, projectiles, fuzes (including safe and arm devices for air-to-air missiles), dispensers, seekers, explosives, carriage and release equipment, aerodynamic and structural technologies, fiber optics, solid-state inertial components, exterior ballistics, and lethality and vulnerability assessment techniques. Some examples of desired research are: low drag/observable weapon airframes; conformal/internal carriage techniques; millimeter wave-seekers for mid-course and terminal guidance; sensor fusion; heavy metal, self-forging fragment warheads; heavy-metal shaped charges; long-rod penetrators; reactive fragment warheads; computational fluid dynamics including interactive grid-generation techniques, and warhead hydrocode-assessment techniques; hard-target weapon technology; and autonomous guidance.

AF93-165 TITLE: Computerized Dynamic Chemical Dispersion Model for Reactive Materials Applications

CATEGORY: Exploratory Development

OBJECTIVE: Develop a chemical dispersion computer model for modeling the effects of reactive materials.

DESCRIPTION: The most commonly used chemical dispersion models account for the dissemination of many different compounds, but none are dedicated solely to reactive materials. The current models are effective in determining the range of contamination of different chemicals in the event of spills, accidents, etc. But, there are no known models that will predict the reaction products of reactive chemicals in the area near the point of release. For example, the effect of the reactive chemicals

or by-products on the ground, air, plant material, etc. The goal of this task is to develop a computer model that will predict reaction products and downwind drifts so that all of the possible environmental outcomes of a reactive weapon test can be accounted for. The model should perform all of the calculations necessary for prediction using specified quantities of reactive material for any type of dispersion method (e.g., a spill, an explosive dispersion, an impact dispersion). The model must also be able to calculate contamination contours from the point of release as well as give the expected concentration of contamination at any particular distance from the point of release. Phase I of this SBIR should consist of an analysis of existing prediction techniques, collection of data on the reactive materials to be included in the proposed model, and designing the dynamic chemical dispersion model. In Phase II the model design will be implemented, the software written, and the documented model delivered for use by the Government. Many commercial uses are envisioned for predicting environmental hazards from reactive chemicals.

AF93-166 TITLE: Advanced Airborne Interceptor Simulator (AAIS)

CATEGORY: Advanced Development

OBJECTIVE: Develop Cooling and Antenna Pointing Techniques for the Advanced Airborne Interceptor Simulator Pod.

DESCRIPTION: The Air Force is developing a test capability to simulate wave forms, modes, and power levels of advanced threat airborne interceptors. The Advanced Airborne Interceptor Simulator (AAIS) will be a pod mounted simulator designed to achieve a high degree of autonomy possibly including carriage on non test-coded fleet aircraft. The technical challenges of this pod mounted simulator includes pod cooling and antenna pointing. The threat simulator will operate in the 9-10 GHz frequency range with a power output of approximately 3KW. The range of operation should be up to 100 nautical miles with a total field-of-view of sixty to ninety degrees. Innovative concepts are desired to explore various alternatives for cooling a twenty-two inch pod containing the threat simulator. Concepts are also desired to explore alternative means of antenna pointing. A design requirement of AAIS is to successively and accurately point the transmit antenna at multiple targets involved in the test scenarios. Possible sources of data for the AAIS Antenna Pointing System are either the Global Positioning System (GPS) or the Air Combat Maneuvering Instrumentation System (ACMI). Methods are sought to slave/interface the AAIS antenna to the TSPI source in the pod, thus allowing the transmitter to illuminate the targets.

AF93-167 TITLE: Two-Dimensional Electronically Steerable Monopulse Millimeter Wave Antenna

CATEGORY: Exploratory Development

OBJECTIVE: Develop a two-dimensional electronically steerable monopulse millimeter wave (MMW) antenna for air-to-air missile seekers.

DESCRIPTION: One-dimensional electronically steerable MMW antennas have been developed but they are not suitable for the dynamic environment of air-to-air missile engagements. MMW phase shifter and gain control component technology has improved sufficiently so that two-dimensional electronic beam steering is now feasible. Two-dimensional electronically steerable monopulse antennas, capable of handling high scan rates without the use of gimbal systems, would greatly enhance the performance of air-to- air missiles. Moreover, the use of a MMW radar in air-to-air scenarios significantly reduces susceptibility to counter- measures and increases the probability of kill because of higher guidance angle accuracies. The technical challenge of this project is to develop the low cost components needed to construct a two-dimensional electronically steerable MMW monopulse antenna sized for an AMRAAM class missile. The challenge also includes the development of a monopulse feed network to output the sum, delta azimuth, and delta elevation channels. Recent developments in size reduction and increased power output of MMW solid state transmitters provide the technology base. Phase I includes analysis and design of the antenna and monopulse feed network suitable to implement MMW antennas with beam steering circuitry. Phase I will culminate with the recommendation of a candidate approach to incorporate the MMW components into the antenna and feed network design to be demonstrated in Phase II. Phase II includes the laboratory demonstration of the components of the two-dimensional electronically steerable monopulse MMW radar antenna designed in Phase I. The demonstration should accomplish two-dimensional beam steering. Phase III of this SBIR task is to produce a prototype antenna sized to fit an AMRAAM-class missile. This antenna would have to be capable of electronically steering the beam in two dimensions and be capable of handling output power loads of 250 watts average.

AF93-168 TITLE: Solid State Materials for Spatial Light Modulators

CATEGORY: Exploratory Development

OBJECTIVE: Develop and test new, innovative materials for use in spatial light modulators.

DESCRIPTION: The Air Force has considerable investment in programs relating to optical processing and optical computing. Light modulation devices are used in many processing techniques. The materials used to effect the modulation often have slow response times or require high voltages. Materials are needed which can modulate an optical beam rapidly and with as low a voltage as possible. Response times of less than 10^{-6} sec and voltages of 100 volts or less are desired. Materials which modulate wavelengths from .4 to 12 micrometers are sought, although it is not intended that the same material cover this whole spectral region. Materials with good figures of merit for modulator materials should be considered. Eventual use of the materials in a two-dimensional spatial light modulator is expected. Phase I is intended to be a survey of existing knowledge, theoretical development for prediction of performance potential of new materials, and demonstration of new materials if possible. Phase II is to consist of development of new materials based on results of Phase I and the design and fabrication of a limited-scale pixelated device to function as a two-dimensional spatial light modulator.

AF93-169 TITLE: Innovative Techniques for Optical Pattern Recognition/Optical Correlation

CATEGORY: Exploratory Development

OBJECTIVE: Develop innovative techniques for optical pattern recognition/optical correlation.

DESCRIPTION: Traditional optical pattern recognition uses two- dimensional correlation to accomplish acquisition and identification. These methods include conventional two- dimensional lenses, spatial light modulators, and optical components. The optical systems using these methods are subject to certain size constraints in order for these elements to perform their function. In addition, two-dimensional modulators currently limit performance of the optical correlator. It is the purpose of this program to investigate unconventional techniques for processing of two-dimensional information. These may include one-dimensional processing, hybrid (digital/optical) processing, acousto-optic processing, integrated optic processing, etc. Phase I includes design and initial demonstration of the concept. Phase II is to include a full-scale packaged correlator which is to be flight tested by the Government. The complete pattern recognition system/correlator to be demonstrated in Phase II is to be small (less than 1 cubic foot) and light (less than 44 pounds).

AF93-170 TITLE: Low Cost Aerodynamic Control Surfaces for Compressed Weapon Carriage

CATEGORY: Exploratory Development

OBJECTIVE: Develop innovative low cost methods and devices for weapon folding aero control surfaces.

DESCRIPTION: A continuing problem in carrying weapons in conformal or internal carriage aircraft is the interference of fixed wings and control surfaces with the aircraft structure. Many complex mechanisms for folding weapon aero surfaces have been employed throughout the years to enhance compressed weapon carriage and employment from launch tubes and weapon bays. Typically these mechanisms have been complex, costly, and less reliable than desired. A new technique to solve this problem in a simple, inexpensive and highly reliable manner is needed. The goal of this program is to develop mechanisms and materials which will allow the surfaces to be efficiently packaged with little or no increase in weapon diameter, and then deploy at weapon release to provide the required control and stabilization. The technical challenge is to identify suitable metal or composite materials, aero surface materials, develop innovative low cost mechanisms which will allow compressed carriage and deployment, provide the necessary control authority, and withstand the dynamic environment. Both subsonic and supersonic carriage and employment consistent with air-to-surface and air-to-air weapon envelopes are required. Phase I of this SBIR should concentrate on analyzing and defining folding mechanism concepts, surveying potential materials, conducting trade studies, and generating preliminary designs of the preferred concepts. Phase II should include the final design, ground deployment test, wind tunnel test, and structural test of the selected aerosurface concepts.

AF93-171 TITLE: The Role of Texture in Directed Energy Warhead Liner Performance

CATEGORY: Exploratory Development

OBJECTIVE: Investigate Basic Metallurgical Properties and Predict How These Properties Affect Warhead Liner Performance.

DESCRIPTION: Most metals exhibit anisotropic behavior where certain crystallographic orientations exhibit higher mechanical properties than other orientations. Copper has traditionally been the leading choice of directed energy warhead liner material because of ductility, ease of production and effectiveness. Although copper has been a successful liner material, requirements dictated by today's targets necessitates new choices which are more dense with higher dynamic properties. There are other metals which are higher in density and posses low work hardening properties at room temperature. These metals must be investigated to determine their dynamic mechanical properties and optimal initial crystal orientation (textures) and how these parameters affect the final penetrator deformation path and effectiveness. This effort should result in the selection of a higher performance liner material. Phase I of the SBIR task is expected to discover an optimal crystallographic orientation for one promising new liner material. The final selection should demonstrate both the feasibility and efficacy of the material choice. Phase II is expected to fully develop the liner material selected and apply it to a directed energy warhead test. The product should exhibit a new and unique directed energy warhead liner material selection as well as demonstrate a methodology for making future selections.

AF93-172 TITLE: Target Vulnerability Assessment Codes and Computational Continuum Mechanics Codes Synergism

CATEGORY: Basic Research

OBJECTIVE: Integrate the fundamental physical approach of continuum mechanics codes into conventional weapons target vulnerability methodologies.

DESCRIPTION: Vulnerability analysis methodologies have been developed over the past thirty years to assess the broad ranges of weapons/target interactions, allowing weapon developers to make difficult design decisions. During the same period, cost effective and accurate computational continuum mechanics codes (hydrocodes) have been developed for detailed weapon/target interaction issues. These developments have been possible due to the availability of more powerful computational resources at reduced cost and enhanced understanding of the behavior of materials under extreme loading conditions. The complexity of targets, changing delivery conditions, smart weapons, precision guidance, and an increasingly broad range of possible kill mechanisms frequently stretch the empirical data bases that are the core of many current vulnerability codes beyond their credible limits, requiring extensive and often prohibitively expensive additional testing. The technical challenge is to integrate, through links with hydrocode technology, as much fundamental physics into vulnerability methodologies as is necessary to achieve accurate assessments of weapon concepts being analyzed. Modified vulnerability methodologies relying on a computational data base to augment existing experimental data need to be explored. Such an approach, for example, might recognize that fracture characteristics of a target material for an armor penetration process fall outside the range of materials used to develop point burst models being used, and lead to a sequence of hydrocode calculations to build a data base in a format usable by the analysis code. Compatibility of data structures, and capacities to communicate between codes with minimal degradation of technical content is essential. Proposals should be limited to one of the following classes of engagements with its perspective target characteristics: air-to-air, air-to- ground fixed hardened targets, or air-to-ground heavy armor mobile targets. The results of Phase I should confirm the proof of concept by exercising a software subset of the overall methodology capable of demonstrating the approach. Phase II would develop the complete software solution proposed and apply it to several applications, demonstrating the validity of the approach. Phase III is commercial support of valid DoD requirements.

AF93-173 TITLE: Enhanced Lethality Thru Tailored Reactions

CATEGORY: Exploratory Development

OBJECTIVE: Increase warhead lethality through a tailored blast pulse or reactive fragment.

DESCRIPTION: Much of the energy from a conventional high explosive warhead is wasted. The fragments may pass directly through the target, carrying most of their kinetic energy with them. The blast, even when the warhead is buried beneath a

runway, tends to vent itself; its energy literally going up in smoke. If the fragment were to 'explode' in the target the lethality would dramatically increase. The fundamental goal of this task is to demonstrate warhead improvement based on the principles of multi-phase, multi-material reactions, tailored reaction rates, equations of state of soil, terminal ballistics of reactant filled fragments, and reacting flow in turbulent media. Successful explosive modes, improved theoretical concepts, or new experimental techniques could provide tools to weaponize this promising technology. The technical challenge includes the lack of previous work in this area, the heterogeneous nature of the materials, and the variety of potential mechanisms. The Phase I effort should clearly define the approach to obtain tailored blast or reactive fragment warhead designs, improved theoretical concepts, or experimental techniques. Phase II is expected to fully develop the approach and apply it to the terminal ballistics, reactive flow, tailored rate or other pertinent warhead technology area.

AF93-174 TITLE: Passive Millimeter Wave Imaging

CATEGORY: Exploratory Development

OBJECTIVE: Obtain one meter cross range resolution at one kilometer employing innovative passive millimeter wave imaging.

DESCRIPTION: Recent developments in Millimeter Wave Microwave Monolithic Integrated Circuits (MIMIC) now permit the employment of high resolution focal plane array techniques for passive millimeter wave imaging. The arrays along with associated optics, electronics and circuitry for image processing and display, can all be constructed at very affordable costs. Still to be achieved, however, is sufficient MMW image resolution to perform the Automatic Target Recognition function. It is believed that through proper array element layout and signal processing techniques, that cross range resolution on the order of one meter can be achieved. Phase I objectives will be to investigate potential superresolution techniques, to design, investigate, and simulate the performance of various focal plane arrays and associated optics, and to propose a candidate approach to be developed and demonstrated in Phase II. The design shall be constrained by an aperture diameter no greater than 30 centimeters. Phase II will include a laboratory demonstration of an imaging array module capable of three meter resolution or less. The demonstration hardware must be transportable and of a size such that demonstrations may be conducted from the tower atop Building 13A of the Wright Laboratory Armament Directorate, Eglin AFB, FL. Phase III is expected to provide a prototype imaging device constructed from replicated Phase II modules with combined capability of achieving the desired one meter image resolution at one kilometer.

AF93-175 TITLE: Explosives with Improved Mechanical Properties

CATEGORY: Exploratory Development

OBJECTIVE: Develop explosive compositions with greatly increased mechanical strength.

DESCRIPTION: Explosives with improved mechanical properties are desired in future warheads and penetrators. Explosives should retain their integrity during hard target impact. Improvements in tensile strength, compressive strength and stiffness are areas of increasing interest among weapons designers. Phase I should result in the design of explosive formulations with improved mechanical properties. Both explosive performance and mechanical properties should be predicted and the processing method documented. In Phase II poured or cast samples will be prepared and tested by both the contractor and the High Explosive Research and Development Facility at Eglin AFB, FL.

AF93-176 TITLE: Infrared Spectral Imaging Radiometer (IRSIR)

CATEGORY: Exploratory Development

OBJECTIVE: Design and develop an infrared spectral imaging radiometer.

DESCRIPTION: Extensive work has been accomplished by the electro-optics industry in the development of spectral radiometers employing circular variable filter (CVF), dispersive element/multiple detectors and fast Fourier transform spectrometer technology. These systems have progressed to capabilities of high spectral resolution and high spectral rates. Exploitation of focal plane array detector technology will provide these capabilities in high performance aircraft in a compact

pod carriage arrangement. The primary goal of this task is to explore the feasibility of integrating the spectrometer technology with the focal plane array detector technology resulting in an IRSIR. The technical challenge will be to provide this capability in the spectral range from 0.2 to 12 micrometers. The design approach should indicate how this range will be covered. Phase I will include a study culminating in a recommendation of a candidate design approach to be demonstrated in Phase II. Phase II is expected to demonstrate, in a laboratory environment, the candidate approach. This phase should also address the method of recording and analyzing the collected data obtained during testing. Phase III is expected to produce a working IRSIR operating at a spectral resolution and spectral rate to be sponsor approved.

AF93-177 TITLE: Replacement Materials for Chromates in Coatings and Sealants

CATEGORY: Exploratory Development

OBJECTIVE: Determine the best environmentally benign substitute for chromium compounds in Air Force coatings and sealants.

DESCRIPTION: The United States Air Force would like to reduce or eliminate the use of chromium compounds to reduce heavy metal pollution of the environment. Large amount of chromates are used in Chemical Conversion Coating of Aluminum (MIL-C-5541), Primer Coating of Metals (MIL-P-23377), and Corrosion Inhibiting Sealing Compounds (MIL-S-81733). Chromates provide outstanding corrosion protection to metals by inhibiting the corrosive action of the environment. Phase I of this SBIR task will include a survey of candidate materials, excluding the heavy metals targeted for elimination, and the collection of information regarding their ability to inhibit corrosion. Analysis of this information will produce a list of candidate materials for replacement of the chromates in the three products referenced above. A test plan will be devised to evaluate the corrosion inhibiting properties of the candidate materials against the currently used chromium compounds. Some preliminary tests of candidate materials in Phase I is desirable. Phase II will consist of incorporating the candidate materials from Phase I into the military products listed above. These products will then be tested using the full gamut of tests contained in the product specifications. Samples of chromate containing products from the qualified products list will also be tested. The tests will be modified in order to gain relative worth (as opposed to pass/fail) information. If successful, Phase III would result in the commercialization of the products.

AF93-178 TITLE: Fiber Optic System for Delivery of High Power Laser Radiation

CATEGORY: Exploratory Development

OBJECTIVE: Develop a fiber optic system to deliver high power Nd:YAG radiation

DESCRIPTION: The Air Force is developing a high power laser system to neutralize unexploded ordnance (UXO) called the Mobile Ordnance Disrupter system (MODS). The use of a laser to neutralize munitions will allow explosive ordnance disposal (EOD) personnel to engage munitions at safe ranges regardless of fuzing type (electronic, mechanical, or magnetic) and case material. Furthermore, the laser damage mechanism will normally cause a low order explosion reducing collateral damage. However, the system is only effective against line-of-sight targets. The primary goal of this initiative is to develop a fiber optic system so the laser beam can be propagated to the target via a non-line-of- sight fiber. This delivery system will provide the added flexibility to acquire and neutralize unaccessible targets. The technical challenge is the development of a method to couple a high power (2000 watt) Nd:YAG laser beam with approximately 20 milliradian beam divergence into a fiber-optic cable with a focusing element on the end to project the laser beam onto the target. The fiber-optic cable will also be used for target acquisition so it must contain a camera lens. The system must be designed so both lenses (focusing and camera) are relatively inexpensive and easily replaced. The Phase I effort will define the system requirements, determine the state-of-the-technology and demonstrate the transmission of the high power divergent, laser beam onto a target in the laboratory. Phase II will require the development of the system, integration with MODS and demonstration of the concept. Phase III will explore agile beam pointing applications such as precision cutting, welding and soldering.

AF93-179 TITLE: Fullerene-Based Initiator Materials

CATEGORY: Basic Research

OBJECTIVE: Develop explosive initiator materials using fullerene carbon spheroids to provide isolation between fuel and oxidant.

DESCRIPTION: Fullerene (or buckminsterfullerene) is a metastable microscopic carbon structure, uniquely different from graphite or diamond, that consists of 60-carbon, 76-carbon, or 120-carbon molecules patterned in the form of a geodesic sphere. Fullerene carbon spheroids are inert and large enough to surround small clusters of atoms; it has been shown that each fullerene molecule can encapsulate 3 potassium atoms, for example. The Phase I task is to encapsulate tiny clusters of atomic or molecular fuel (or oxidant) with fullerene in order to provide metastable isolation from an oxidant (or fuel) to create a new type of explosive initiator material. Initial feasibility demonstration will involve successful detonation of at least one such metastable mix of fuel and oxidant via shock, heat, electricity, incident photons, or other means. Subsequent Phase II work will be a concentrated effort to refine and characterize the explosive to optimize its performance and prepare it for qualification testing.

AF93-180 TITLE: High Surface Area Materials

CATEGORY: Exploratory Development

OBJECTIVE: Determine phenomena responsible for high surface area nucleation/growth for exploitation as electrode materials.

DESCRIPTION: A substance has relatively high surface area (HSA) if it exhibits an area of at least 100 square meters per gram as indicated by gas absorption tests. HSA materials can provide a means by which a process may proceed in a confined volume or at enhanced speed. Catalytic converters, dimensionally stable anodes, and double layer capacitors are examples of devices which use HSA material either in granular or layered form. Direct processes for precipitation of HSA powder have been developed because of the need for catalysts. However, existing procedures for HSA layer formation are not applicable to a wide variety of materials. The ability to engineer electrodes for specific purposes is therefore quite restricted. Phase I research will involve an analysis of all published data pertinent to the problem of how to grow potentially useful HSA films (such as transition metal oxides, nitrides, and borides) as electrodes for capacitive energy storage. Conductivity, substrate adhesion, electrochemical stability, and double layer capacitance when used with a given electrolyte are major considerations. Ease of fabrication, availability/cost, and growth rate or layer thickness limitations should also be considered. A successful Phase I effort would include a laboratory demonstration of a novel electrode/electrolyte system that offers exceptional energy storage capabilities. Phase II efforts will be directed towards optimization of planar electrode fabrication techniques and packaging of stacked or rolled cells for long term usage.

AF93-181 TITLE: High Speed Data Acquisition for Fuzing

CATEGORY: Exploratory Development

OBJECTIVE: Design a high speed digital data acquisition system for use with fuze sensors.

DESCRIPTION: Recent technology advances have produced 8-bit flash analog-to-digital (A/D) convertors that are fast enough (300 mega samples per second) for fuze sensor applications while still being affordable and meeting military specifications. There is a requirement to couple these devices with appropriate memory and simplified controller for fuze sensor applications. The technical challenge is to design the complete high speed data acquisition package into a volume no greater than 2 cubic centimeters. The memory requirements are a minimum of 200 bytes of data. The desire and technical challenge is to extend the design of the high speed memory to 16K bytes. The controller must continually store all data in memory; wrapping around such that pre-trigger information can be obtained. The three main functions of the integrated device are: a) continuous data acquisition (wrapping around) on command from an external source, b) stop acquisition on command from an external source, and c) data transfer to external device. The amount of pre-trigger information available should be user definable and preset before the unit is placed into operation. Phase I program design should show feasibility of the concept and minimum package size along with baseline operating specifications (power requirements, power consumption, heat dissipation, temperature, humidity, "g" loading, etc.). This design should also include interface to a laboratory PC-based computer for data transfer demonstration. Phase II of the program would emphasize construction of several demonstration devices along with testing to determine their actual operating environment limitations. Phase III applications of this device include laser rangefinders, collision avoidance sensors, intrusion detectors, and optical research involving time of flight data.

AF93-182 TITLE: Solid State Scanner for Laser Radar (LADAR) Systems

CATEGORY: Exploratory Development

OBJECTIVE: Develop a laser radar scanning system which does not use mechanical moving parts.

DESCRIPTION: LADAR systems have been built which use scanning mirrors and other devices to direct the laser beam and return energy. These systems, though very capable of directing the beam in a systematic method, are not very flexible for use in scanning systems which could make better use of the laser beam by scanning in non-linear patterns or dwelling on interesting features based on feedback from a processor. A solid state device which could be scanned in a random pattern on command with little delay would greatly enhance the capabilities of LADAR systems. The device should provide at least a 45 degree by 15 degree scan pattern and operate with laser pulse powers of at least a few kilowatts. The device must be small, lightweight and not produce a large electromagnetic interference signal during operation. The device should not waste or absorb more than ten percent of the energy transmitted or received. Phase I of this project would identify technologies which satisfy this need, determine the theoretical limits of various techniques, and demonstrate the best technique in a laboratory using an applicable laser and pulse rate. Phase II would develop prototype hardware capable of being installed in a working LADAR to demonstrate the capability of the technology.

AF93-183 TITLE: Ferromagnetic Polymer Inductive Coupling for Fuzing

CATEGORY: Exploratory Development

OBJECTIVE: Design ferromagnetic polymers to enhance efficiency and ruggedness of inductive couplers for penetrator weapon fuzes.

DESCRIPTION: Inductive couplers are foreseen as an implement to modular design of advanced fuzes. It has been demonstrated that in-line fuze circuit modules can be coupled inductively as opposed to ordinary physical connection via conventional means. Ferrite pot cores have been used for increased inductive coupling efficiency, but their brittleness makes them undesirable for hard target penetrator fuze applications. Blending ferrite powders with polymers greatly improves pot core ruggedness, but coupling efficiency suffers since there is no ferromagnetic contribution from the polymer matrix. Likewise, coupling through a polymer fuze housing presents similar problems. What is needed is a ferromagnetic polymer that can be used as a binder with ferrite powder in order to make a high-G impact survivable pot core that has high coupling efficiency. Phase I of this program would include evaluation of ferromagnetic polymers and a characterization of magnetic and mechanical properties of various ferrite polymer/powder blends. The result of Phase I would be the selection of several material compositions for inclusion in the Phase II fabrication/test program. Phase II would advance this technology towards high impact strength pot core fabrication and include a demonstration of improved inductive coupling efficiency. Copolymerization experiments covering the potential thermoplastic fuze housing materials would be included.

AF93-184 TITLE: Emerging Technologies Resulting in Lighter Aircraft, Increased Engine Performance, and Improved Design Tools

CATEGORY: Basic Research

OBJECTIVE: Improvements in aircraft structure, scramjet performance, and aerodynamic design technologies.

DESCRIPTION: The National Aero-Space Plane is providing a quantum jump in aerospace technologies by investigating new and innovative solutions. Its goal is a Mach 25 air-breathing scramjet vehicle capable of single stage to orbit. Emerging technologies providing significant performance improvements for the aircraft will be considered. Phase I must show experience and understanding of the relative importance of the technologies. It must also provide detailed drawings, specifications, and test procedures for the proposed application of the technologies. Phase II requires prototype and associated test results demonstrating decreased weight, increased scramjet performance, or improved aerodynamic design tools without increased liabilities. Potential Phase III customers include the five members of the NASP Industry Team, Government laboratories, the computer industry, and the automotive industry.

AF93-185 TITLE: Integrally Woven Lightweight High Temperature Composite Structures

CATEGORY: Basic Research

OBJECTIVE: Lightweight, structurally efficient design approaches for high temperature composite materials using methods of integral weaving.

DESCRIPTION: Advanced, lightweight airframes having structural weight fractions as low as 0.1 are required for future high performance aerospace vehicles, such as the NASP and its derivatives. These vehicles will operate in severe high temperature environments which are beyond the limitations of many current materials. Metallic and nonmetallic composites, such as metal matrix, carbon-carbon and fiber reinforced ceramics, are promising classes of materials having potential application to such future vehicles. Joining methods to achieve structural assemblies using these materials are under development, but much work remains. An alternative to joining, where practical, is to employ integral weaving to greatly reduce or eliminate the required joining of discrete parts. Innovative methods are thus required to achieve basic woven structural shapes for panel and joint regions which are lightweight, structurally efficient, and which exploit the inherent characteristics of the candidate materials. Application areas are for service temperatures greater than 1000°F and include airframe and engine components, both cooled and uncooled, and heat shields. In the Phase I proposal, offerors should demonstrate a clear understanding and familiarity with the technical issues and should clearly explain the uniqueness of their approach. Phase I will establish the technical feasibility of candidate, innovative weaving methods along with matrix consolidation. Limited, small specimen mechanical testing should be performed to aid in assessing feasibility. Phase II will scale up the process to larger structural sections, generate mechanical property data, and perform testing to verify structural integrity over required lifetimes. Potential Phase III customers include the automotive industry and military and civilian aerospace.

AF93-186 TITLE: Structural Integrity Analysis Techniques for Extreme Environments

CATEGORY: Basic Research

OBJECTIVE: Methods to measure crack length and estimate the life of structural components in extreme environments.

DESCRIPTION: Future high performance aerospace vehicles such as the National Aero-Space Plane (NASP), will operate in extreme thermomechanical environments. The operating temperature of their structural components can easily exceed 2000°F. Properties of materials and joints are greatly affected by these temperatures. Therefore, to ensure the safety of these vehicles, reliable methods to measure crack growth and estimate life remaining for small structural component test specimens are required. Since future vehicle components will consist of metallic, polymer-matrix composite, metal-matrix composite, and refractory-matrix composite materials, it is desirable that these methods be applicable to a number of material systems. Phase I should result in the development of innovative methods to measure crack growth accurately and estimate life for small structural component test specimens operating at high temperatures. Phase II includes validation over a broader data base and would yield a prototype product. Phase III of this project would entail the refinement and commercial offering of these techniques

AF93-187 TITLE: Enhanced Thermal Conductance in Nonmetallic Heat Exchangers

CATEGORY: Basic Research

OBJECTIVE: Enhanced thru-thickness thermal conductance of refractory composite heat exchangers operating at 2500°F to 2800°F.

DESCRIPTION: Airbreathing propulsion systems of future high- performance aerospace vehicles such as NASP and NASP derivatives, will operate at heat fluxes substantially greater than current state-of-the-art airbreathing engines.

In order to reliably withstand these high heat fluxes, regeneratively cooled channeled structures fabricated from copper alloys, high-temp iron and cobalt-based superalloys and refractory composites such as coated C/C and C/SiC are receiving developmental consideration. These materials must be able to contain high-temperature, high-pressure hydrogen without severe leaking or excessive degradation of mechanical properties while surviving highly oxidized and reducing combustion products. C/C and C/SiC refractory composites have demonstrated high-temperature strengths superior to superalloys by

700 to 1200° F and coatings have been developed exhibiting reasonably acceptable oxidation resistance to 3000° F. In order to use this capability in a heat exchanger, methods to increase the thermal conductivity through the heat exchanger walls are needed while containing the hot high-pressure hydrogen and avoiding unacceptable permeation. Current designs involve nonpermeable refractory metal channel liners in the carbon or ceramic matrix composites. Achieving adequate interfacial heat transfer is a leading problem with this design approach and alternate approaches incorporating alternate fiber architectures and nonmetallic channel wall liner materials are needed. The Phase I program will establish a candidate method. During Phase II, the contractor will build and demonstrate a prototype heat exchanger and in Phase III, the contractor will refine and market his process and/or material.

AF93-188 TITLE: Surface Measurement of Hypersonic Boundary Layer Instability Modes

CATEGORY: Basic Research

OBJECTIVE: Surface-mounted sensor capable of measuring stationary or traveling instability waves in hypersonic boundary layers.

DESCRIPTION: Measurements of the growth and spatio-temporal frequency content of instability waves in hypersonic boundary layers are required to diagnose transition prediction techniques, to diagnose the dominant instabilities leading to transition in wind tunnel and flight experiments, and as a precursor to any active control scheme. Surface mounted sensors are highly desirable for these measurements, since they are relatively nonintrusive and easily mounted. Such surface mounted sensors as hot films and microphones have been used successfully for these measurements in subsonic flow, but no such measurement capability has been demonstrated for hypersonic flow. A number of sensors, including optical, hot film, pitot pressure, surface microphones, etc, exists for detecting transition locations in hypersonic flow. While these instruments give some indication of where a hypersonic boundary layer transitions from laminar to turbulent, they return little, if any, information about the instability growth leading to transition. There are two primary reasons for this. First, instability waves in hypersonic flow possess maximum energy at the edge of the boundary layer and, in contrast to subsonic flow, there is little coupling between the waves and the wall variables. Mass flux variations caused by hypersonic instability waves can be several percent at the boundary layer edge, but their surface footprint may be extremely small in magnitude. Second, the frequency range of traveling instability waves in hypersonic flow stretches or exceeds the frequency response of existing instrumentation. The detection of stationary (cross flow or Goertler) instability waves is also problematic, since it is necessary to look for small variations in the spatial distribution of the mean measurement quantity. The measurement of hypersonic instability waves is the most demanding test of such instrumentation. If the instrumentation has enough sensitivity for this task, it should in principle be usable at lower Mach numbers and in turbulent flow. The Phase I effort will analyze the proposed measuring system and demonstrate its feasibility. In Phase II, the system will be installed and demonstrated at Wright Laboratory. In Phase III, the technology demonstrated in the first two phases will be commercially exploited.

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

Submission of Proposals

The responsibility for carrying out DARPA's SBIR Program rests with the Office of Administration and Small Business. The DARPA Coordinator for SBIR is Dr. Bud Durand. DARPA invites the small business community to send proposals directly to DARPA at the following address:

DARPA/OASB/SBIR
Attention: Dr. Bud Durand
3701 North Fairfax Drive
Arlington, VA 22203-1714
(703) 696-2448

The proposals will be processed in the Office of Administration and Small Business and distributed to the appropriate technical office for evaluation and action.

DARPA has identified 32 technical topics, numbered DARPA 93-001 through DARPA 93-032, to which small businesses may respond in the first fiscal year (FY) 1993 solicitation (93.1). Please note that these are the only topics for which proposals will be accepted at this time. Proposals can no longer be accepted on those previously advertised 97 technical topics which were numbered DARPA 92-130 through DARPA 92-226. A list of the topics currently eligible for proposal submission is included below, followed by full topic descriptions. The topics originated from DARPA technical offices.

DARPA's charter is to help maintain U.S. technological superiority over, and to prevent technological surprise by, its potential adversaries. Thus, the DARPA goal is to pursue as many highly imaginative and innovative research ideas and concepts with potential military applicability as the budget and other factors will allow. In the early years of the SBIR program most of the promising Phase I proposals could be funded, but as the program's popularity increased, this became more and more expensive. DARPA therefore instituted program changes to fund more Phase Is. These included increasing the number of SBIR topics, and setting more funds aside for Phase I proposals. In order to do this and still have a reasonable amount of funds available for the further development of promising Phase Is, the Phase II limit was lowered to $250,000.

DARPA selects proposals for funding based upon technical merit and the evaluation criteria contained in this solicitation document. As funding is limited, DARPA reserves the right to select and fund only those proposals considered to be superior in overall technical quality and highly relevant to the DARPA mission. As a result, DARPA may fund more than one proposal in a specific topic area if the technical quality of the proposals in question is deemed superior, or it may fund no proposals in a topic area. Each proposal submitted to DARPA must have a topic number and can only respond to one topic.

DARPA has prepared a checklist to assist small business activities in responding to DARPA topics. Please use this checklist prior to mailing or handcarrying your proposal(s) to DARPA. Do not include the checklist with your proposal.

DARPA 1992 Phase I SBIR

Checklist

1) Proposal Format

a.	Cover Sheet - Appendix A (identify topic number)	____
b.	Project Summary - Appendix B	____
c.	Identification and Significance of Problem or Opportunity	____
d.	Phase I Technical Objectives	____
e.	Phase I Work Plan	____
f.	Related Work	____
g.	Relationship with Future Research and/or Development	____
h.	Post Potential Applications	____
i.	Key Personnel	____
j.	Facilities/Equipment	____
k.	Consultants	____
l.	Prior, Current, or Pending Support	____
m.	Cost Proposal - Appendix C	____

2) Bindings

a.	Staple proposals in upper left hand corner.	____
b.	Do not use a cover.	____
c.	Do not use special bindings.	____

3) Page Limitation

a.	Total for each proposal is 25 pages inclusive of cost proposal (Appendix C) and resumes.	____
b.	Beyond the 25 page limit do not send appendices, attachments and/or additional references.	____

4) Submission Requirement for Each Proposal

a.	Original proposal, including signed **RED** Appendices A and B.	____
b.	Four photocopies of original proposal, including signed Appendices A and B.	____
c.	One additional photocopy of Appendices A and B only.	____

SUBJECT/WORD INDEX TO THE DARPA SBIR SOLICITATION

INDEX OF DARPA FY 93 TOPICS

DARPA 93-024	Point-of-Use Generation and Disposal of Wafer Process Chemicals
DARPA 93-025	Hybrid Image Understanding (IU)/Neural Net (NN) Techniques for Target Recognition and Multisensor Fusion
DARPA 93-026	Semantic Search of Information Database
DARPA 93-027	Voice Authentication Monitoring System
DARPA 93-028	Computational Sensors
DARPA 93-029	Sensor and Algorithm Planning & Allocation for Use in Image Understanding
DARPA 93-030	Bubble-Based False Undersea Targets
DARPA 93-031	Intelligent, Modular, Scalable Controllers and Actuators for Use in Automated Systems
DARPA 93-032	Synthetic Dolphin Blubber Compliant Coatings

DARPA 93-001 TITLE: Use of Meteor Scatter for Long-Range Position Location of High Frequency (HF)/Very High Frequency (VHF) Transmitters

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Develop, analyze, and assess the performance of a system for locating the position of high frequency (HF) and very high frequency (VHF) transmitters using energy from these transmitters that incidentally scatters from meteor trails. Build and demonstrate the system in a real-time field test capitalizing, if possible, on the DARPA meteor scatter test link.

DESCRIPTION: Energy from HF and VHF emitters will inadvertently be scattered from meteor trails. The major assumption in this task is that knowledge of the meteor scatter phenomenon and measurements of the arriving signal can be coupled to derive the information necessary to geolocate these emitters. The basic questions to be answered by this SBIR are: How accurately can a remote emitter be located using the meteor scatter channel and a realistic baseline system? What are the system requirements to achieve geolocation within a given error bound? What is the algorithm for solving the meteor scatter geolocation problem? What is the performance of the proposed meteor scatter geolocation system under realistic meteor scatter propagation channel conditions? How sensitive is the performance of the proposed system to variations in the channel, errors in the signal measurement system, variations in the Effective Radiated Power (ERP) of the emitter, and the waveform of the emitter? How well does the proposed system perform in non-real time but with real channel data? And finally, how does the proposed system perform in real time on a real meteor scatter link at various ranges? The contractor will perform analytic and design studies in Phase I. In Phase II, the contractor will instantiate algorithms in a real machine for simulation and for non-real time performance evaluation. Phase II ends with a demonstration of the geolocation system on a real meteor scatter test range.

Phase I: The following issues will be addressed:

1. What measurements and accuracies are required to bound with 90% confidence the position of the remote emitter within a circle of diameter: a. 10 miles, b. 1 mile, c. 0.1 mile?
2. The sensitivity of these error circles to emitter ERP and propagation and range variances associated with real meteor scatter channels.
3. The basic architecture and essential requirements of the major components of the meteor scatter position location (MSPL) system. From this, establish a baseline of overall performance and critical component performance requirements for the MSPL system.
4. The time required to achieve a given circular error as function of emitter ERP assuming the baseline MSPL system.
5. The algorithms for solving the MSPL problem.

Phase II: Develop a non-real time simulation of the MSPL problem and demonstrate the performance of the proposed MSPL architecture and algorithm. Demonstrate the performance of the MSPL algorithms in non-real time with data taken from a real meteor burst link. Develop a real-time instantiation of the MSPL algorithms on an economical host machine and interface the host machine to the radio frequency portion of the MSPL system. Develop a test plan for proving the accuracy of the MSPL system. Perform a field test in real time and prepare a final report on the test results.

DARPA 93-002 TITLE: Aerospace System Applications of Micromachine Technologies

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Identify and develop systems, subsystems, and/or integrated componentry which exploit advanced micromachine technology and are tailored to aerospace applications.

DESCRIPTION: Advanced electronic chip manufacturing technology has recently spawned a revolutionary new capability to fabricate micromechanical elements and simple systems. These devices, which have been demonstrated to operate at physical scales of 1-200 microns, currently range from simple gears and linkages to more complex micromotor systems. The practical utilization of this technology is dependent on a number of factors, including the development of more complex interactive micromachine elements, or alternatively, the integration of large numbers of simpler elements into macroscale devices; the resolution of inherent mechanical interface problems; and, identification of suitable candidate applications, involving extensions of the technology into both current and potential new areas. Innovative ideas are sought which exploit micromachine technology in aerospace vehicle and related system applications to improve performance, efficiency or

reliability, or which afford innovative alternative approaches to current aerospace technologies. Proposals should display understanding of micro-electro-mechanical systems (MEMS) technology, including fabrication techniques, constraints, and operating limitations, as well as a thorough knowledge of intended aerospace application(s).

Phase I: Establish feasibility and potential for proposed candidate systems, subsystems or integrated componentry which exploit micromachine technology and are tailored to specific aerospace applications. Quantify performance characteristics and establish constraints and limitations associated with the developed approach through analyses, computations, and/or physical experiments. Provide preliminary design, where feasible.

Phase II: Design, develop, fabricate, and test selected micromachine-based systems, subsystems, or integrated components resulting from Phase I efforts. Provide necessary data and information for integration with other system components. Identify manufacturing and production issues and limitations, along with solutions/strategies for resolution.

DARPA 93-003 TITLE: Concepts and Technologies for an Advanced, Tailless, Thrust-Vectored Air Vehicle

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Develop critical enabling technologies for application in feasible candidate concepts of an advanced, remotely-operated, reconfigurable, high-performance, maneuvering air vehicle which employs vectored thrust as its primary means of stability and control at subsonic and supersonic speeds.

DESCRIPTION: Aircraft, such as the X-31 Enhanced Fighter Maneuverability (EFM) demonstrator, are expected to pioneer dynamic maneuvering flight in the post stall regime. This aircraft is equipped with enhanced thrust vectoring capability to provide necessary control authority at high angles of attack and relatively low airspeeds. Future atmospheric flight vehicles can be expected to exploit these unique control capabilities more fully, greatly improving overall vehicle agility, as well as reducing or eliminating the requirement for more traditional aerodynamic control surfaces. The further development of lower amplitude, higher bandwidth, thrust-vectoring methodologies may also provide a means of achieving stability at higher (supersonic) speeds for these vehicles. Innovative ideas which contribute to the development and/or implementation of the critical enabling technologies are sought, along with novel system concepts achievable within the state of the art. The system focus for this effort is on a low cost family of reconfigurable, demonstrator vehicles which embody modern high performance air vehicle characteristics and which are collectively capable of addressing multiple development objectives applicable to manned and/or unmanned flight at all corners of the flight envelope. These objectives could involve a number of design or performance issues, including configuration variations, high speed performance and stabilization, combat agility, complementary alternative aerodynamic control schemes, and propulsion-based control and integration methods, to name a few. Proposals should focus on specific technology elements or issues, but must demonstrate an understanding of their impact to vehicle design and performance parameters. An overall understanding of vectored thrust vehicle issues as applied to airbreathing systems should be incorporated in the proposal.

Phase I: Investigate feasibility of developing, adapting, or implementing candidate technologies or technology suites advocated in the offeror's proposal. Develop solutions to potential design issues or technology constraints, and show potential for integration into candidate system concepts through analysis, computation, and/or experiment.

Phase II: Develop preliminary design(s) for the promising candidate system, subsystem, or critical component investigated in Phase I. Develop and conduct a demonstration which illustrates operational feasibility and assesses performance of the device.

DARPA 93-004 TITLE: Low-Cost, Ultra-Low Power, High Efficiency Power Conditioning/Regulation for Unattended Ground Sensors

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Develop low-cost, low-voltage, ultra low-power, high-efficiency power conditioning/regulation technique for unattended sensors.

DESCRIPTION: DARPA is interested in developing advanced internetted unattended ground sensors (IUGS) for enhanced wide-area surveillance applications. These sensors will use sophisticated signal processing and communications electronics in their design to facilitate several month, extended range operations under an internetted system architecture. This requires advanced power conditioning and regulation techniques designed for low-voltage, ultra-low power, high-efficiency operation.

If the IUGS is to be affordable, these techniques must also be low-cost and easily manufacturable.

Phase I: Conduct a system architecture study which will pursue the requirements addressed above with sufficient data to demonstrate feasibility.

Phase II: Use the approach outlined in Phase I to develop an engineering model, and deliver it to the government for testing.

DARPA 93-005 TITLE: Prototype Implementation of Scalable High Speed Network Services

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Develop prototype implementations of scalable high speed network services compatible with existing internet protocols and with significant new capability in defense-specific functions such as reliability, fault-tolerance, and security.

DESCRIPTION: Prototype implementations of existing or new network services are sought. Implementations of existing services must include a significant new capability in one or more of the following: reliability, fault-tolerance, security, or ability to scale to new levels of network size or performance. Approaches must be compatible with existing internet protocols and must demonstrate innovation. New services must not duplicate existing functions and must address a significant unmet need in the internet.

Phase I: Deliver a detailed design and cost information as well as a complete plan for implementation. Prototypes demonstrating feasibility are desired.

Phase II: Deliver a full implementation and demonstration of the service. Complete user documentation, source code, and system designs must be supplied.

DARPA 93-006 TITLE: Scalable Accelerators and Interfaces for High Performance Computing Systems

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Develop and prototype scalable implementations of accelerators and interfaces for High Performance Computing Systems (HPCS).

DESCRIPTION: Hardware/software accelerators are sought, capable of running in collaboration with general purpose scalable parallel HPCS, which can solve classes of defense problems by 2-3 orders of magnitude faster or demonstrate new interfaces on these systems. The accelerator must either exploit existing standards and open interfaces, define a unique interface and justify its potential benefits, or a combination of the two. Limitations, domains, and applicability for these approaches must be quantified. Demonstrations should be consistent with the goals of the Federal High Performance Computing and Communications Program.

Phase I: Define in detail the candidate accelerator, technical approaches, interfaces, tradeoffs, and risks along with supporting evidence of success, such as early prototyping experiments. Expected performance must be estimated, along with comparative trends in general purpose computing. Define experiments and strategy to test the concepts.

Phase II: Develop, prototype, demonstrate, and deliver the accelerator, along with associated documentation and testing strategy to compare to predictions. Extrapolate costs for replication and use on HPCS.

DARPA 93-007 TITLE: Prototype Implementations of Scalable High Performance Computing (HPC) Software

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Develop novel ideas for advancing HPC Software including compiler technology for scalable HPC computing systems, particularly in the area of code optimization and parallelization; scalable software library modules that can be developed into functioning code for scalable computing systems; novel concepts for supporting scalability in libraries; new operating system functions; and innovative software algorithms.

DESCRIPTION: Concepts are sought for innovative and novel ideas for advancing HPC software for scalable HPC computing systems. Concepts must be described with enough detail to demonstrate system independency and have clearly

defined and open interfaces. The focus should be on the development and refinement of scalability features in HPC software and library modules.

Phase I: Provide a detailed specification of the proposed concept, principle, or algorithm. Describe new or novel ideas for concepts. Describe scalability and parallelism. Demonstrate how the new concept, principle, or algorithm would be used in HPC. Finally, describe the path or process for implementation on HPC computing systems.

Phase II: Develop the software prototype, subsystem, or module which implements the new HPC software technology. Demonstrate the effectiveness of the new technology. Provide documentation that clearly describes the result, any external interfaces, or requirements; how to use the software module; and the system interface. A hard copy and magnetic media copy of any code are required.

DARPA 93-008 TITLE: CVD Non-Contact Temperature Sensor for Feedback Process Control

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Develop non-contact, in-situ sensing techniques for measuring temperature in chemical vapor deposition (CVD) manufacturing processes for feedback control.

DESCRIPTION: Inability to directly measure absolute as well as relative temperature of product in CVD reactors limits the application of intelligent processing of materials (IPM) methods, including feedback control, to these processes. Chemical vapor deposition methods for creating thin as well as thick films of metals or ceramics on substrates are already widely practiced, and significantly improved process control will greatly expand these commercial manufacturing processes. Process yield and product quality can both be substantially improved by application of IPM with feedback temperature control.

Phase I: Identify and experimentally demonstrate feasibility of non-contact in-situ temperature measurements in a CVD reactor.

Phase II: Incorporate successful sensing technology into a CVD manufacturing process or a CVD reactor product line to achieve feedback process control.

DARPA 93-009 TITLE: Flexible Manufacturing of Metal Matrix Composites for Electronic Packaging

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Demonstrate the rapid prototyping capability for the manufacture of metal matrix composite components for use in packaging for multichip modules. Flexible manufacturing methods for near-net-shape components are required for small production runs (100 units/run) of high performance/power density electronic packages.

DESCRIPTION: Metal matrix composites (MMCs) are finding increased attention as packaging materials for multichip modules (MCMs) due to: high thermal conductivity required for heat dissipation; ability to tailor the thermal expansion coefficient to match silicon and/or gallium arsenide (GaAs) chips; and electrical conductivity useful in shielding circuits from electronic noise. Affordable and timely manufacturing methods are desired for small lots of application specific metal matrix multichip modules.

Computer integrated manufacturing (CIM), in which a computer model of the metal matrix package is used for both simulation of performance and the rapid prototyping of the components using Solid Freeform Fabrication (SFF), has the potential to greatly reduce the development time cycle and development costs of high quality metal matrix composite MCMs. SFF is also envisioned as a flexible manufacturing method for small volume production runs. A turnaround time from print to finished MMC MCM prototype of less than seven days is desired. Solid freeform manufacturing can be for either the tooling to produce the package, or the powder preform for the metal matrix composite.

Phase I: Determine material property requirements for MCMs and demonstrate the fabrication of materials in test specimen form with the required properties. The required properties include thermal conductivity and thermal expansion coefficient. The feasibility of using SFF for rapid prototyping will also be demonstrated in this phase.

Phase II: Produce metal matrix MCMs for test and evaluation by an electronic system integrator. Demonstrate the ability to produce parts to print, including meeting all dimensional tolerances, surface finish, and thermal expansion and thermal conductivity requirements, with a seven day turnaround time. The manufacturing demonstration must be relevant to

defense needs, and may be accomplished with collaboration of military service or commercial laboratories for purposes of assessing "customer" acceptance. A minimum of two designs with production runs of 25 or more parts will be demonstrated. Manufacturing reproducibility and quality will be assessed for the rapid prototyping process developed in Phase I.

DARPA 93-010 TITLE: Battery on a Chip (BOC) Feasibility/Applications

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Demonstrate the feasibility of a battery on a microelectronic chip concept with improved performance for a DoD-relevant application.

DESCRIPTION: Several types of thin-film solid state batteries have recently been developed. This technology offers the possibility of providing on-chip power for devices such as microsensors, receivers/transmitters, RAM backup, etc., as well as distributed multichip module (MCM) power. Proposals are sought which couple this novel battery technology with microelectronic devices which would provide improved performance over the more conventional approaches involving a separate power source. A DoD-relevant application using this battery on a chip combination should be defined, and the quantitative advantages of this approach should be discussed in the proposal, along with the manufacturing processes to be utilized in the BOC fabrication.

Phase I: Produce and test promising thin-film solid state batteries for identified battery on chip application.

Phase II: Incorporate candidate battery and chip (or MCM) and evaluate performance.

DARPA 93-011 TITLE: Mechanical Issues in the Application of High Temperature Superconducting Materials

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Analyze the mechanical issues involved in the fabrication and use of high temperature superconducting thin films in such structures as interconnects in semiconductor packaging schemes, or integrated Radio Frequency (RF) circuitry.

DESCRIPTION: The development of residual stresses in thin-film materials, resulting from thermal and chemical strains, is a continuing problem in the synthesis of high quality thin-film superconducting material. Problems arising from residual stresses appear not only in the films, or layers of superconducting material, but also in the layers of dielectric materials and interlayers used to enhance epitaxy, texture, or chemical stability. In an attempt to alleviate this situation, it is necessary to develop a set of analysis tools (primarily computational) to analyze thin-film synthesis procedures vis-a-vis residual stress and epitaxial development.

Phase I: The objectives of this phase are to develop the models and special purpose computational tools necessary to predict (1) residual stresses from thermal and chemical strains, and (2) damage in the form of fracture through the layers (including the substrate) and delamination between the layers.

Phase II: The objective of this phase is to develop, based on the results of the Phase I models, a computational design tool that can be used to explore the effects of structural and design variables. In this way, potentially flawed designs can be avoided and ones with optimal properties can be recognized much faster than would be possible following a purely empirical approach. The design tool should be flexible enough to allow for (1) the addition and subtraction of layers, (2) changes in layer thickness, and (3) changes in the layer's physical properties. Structural features such as vias should be treated also, since it can be expected that stress concentrations due to vias will create additional potential for fracture.

DARPA 93-012 TITLE: Indium Phosphide (InP) Material Growth for Microwave and Millimeter Wave Monolithic Integrated Circuits

CATEGORY: 6.3 Advanced Development

OBJECTIVE: Advance the development and fabrication of InP substrates and epitaxial material for microwave and millimeter wave monolithic format devices and circuits that will provide performance characteristics not presently available and, thus, satisfy system requirements that are not presently being adequately met.

DESCRIPTION: Gallium arsenide (GaAs) is the most common material suitable for use in developing microwave and millimeter wave devices and monolithic format integrated circuits. However, further performance improvements have been achieved using InP as a substrate material, particularly at millimeter wave frequencies. Nevertheless, InP material growth is at an embryonic stage of development and established sources of large diameter (3 inch diameter or greater) InP wafers are not yet available. This project is directed toward the improvement of the microwave and millimeter wave performance characteristics of InP substrate material and substrate/epitaxial combinations. It is expected that this project will also lead to the establishment of sources of supply for large diameter (3 inch or greater) InP wafers with characteristics suitable for high performance and low-cost microwave device and circuit development.

Phase I: Develop a plan for cost-effective techniques for producing InP substrate material and/or InP substrate/epitaxial material combinations that will result in a supply of material with performance characteristics suitable for producing microwave and millimeter wave devices and circuits.

Phase II: Perform appropriate work to begin or extend the development of sources of InP substrate material or substrate/epitaxial combinations with the characteristics described above.

DARPA 93-013 TITLE: Conformal Electronic Packaging

CATEGORY: 6.1 Basic Research

OBJECTIVE: Develop materials and processes for interconnection and packaging of electronic components in arbitrary configurations.

DESCRIPTION: New materials and processes are sought which could enable high density interconnection and packaging of electronic components, digital or digital/analog, in arbitrary spaces. Although there has been much progress in development of high performance printed circuit board and multichip module technology, interconnects are generally processed on rigid flat surfaces. This may result in a poor volumetric match between electronic modules and the space that is naturally available in certain applications (e.g., hand-held). Areas of interest include the deposition of conductors and insulators as well as bonding and attachment of components.

Phase I: Perform preliminary analysis and experimentation on materials and processes.

Phase II: Investigate promising materials and processes and develop interconnect process technology. Demonstrate feasibility of interconnect on curved surfaces through design, fabrication, and evaluation (e.g., electrical, mechanical, thermal, repair/rework) of test structures.

DARPA 93-014 TITLE: Multi-Chip Integration

CATEGORY: 6.3 Advanced Development

OBJECTIVE: Develop tools and technologies which will facilitate the availability of cost-effective multi-chip modules (MCMs) to a wide variety of users.

DESCRIPTION: MCMs are electronic components which consist of a number of unpackaged integrated circuits (ICs) interconnected by some sort of high density interconnect (>1000 (cm of wire)/(sq. cm of area)) and enclosed in a package which is compatible with the next level of systems interconnect. Compared to conventional single chip packaging, MCMs offer significant improvements in system performance, functional density, and reliability. Although MCM technology has been in production at large vertically integrated companies for over 10 years, availability to the broader community has been limited by structural and technological issues. Among them are the ability to procure "known-good" bare die (unpackaged ICs), the ability to achieve first pass success on designs involving existing ICs from multiple suppliers, high non-recurring engineering (NRE) costs associated with introducing new designs, and long design cycle times.

DARPA is soliciting proposals from small businesses which would like to develop and market new technologies or tools which mitigate one or more of the above-mentioned barriers to MCM use. In doing so, we hope to stimulate a vigorous merchant market for MCMs and a robust supplier infrastructure to support that industry. Because of the significant commercial demand which is projected for this technology, we would like to ensure that a common industrial base can serve both the military and commercial markets and thus achieve economies of scale. Specific areas of interest include, but are not limited to, computer-aided design tools, bare die test equipment and methodologies, new approaches to module level

test, simulation and analysis tools, flexible manufacturing and assembly equipment, and component information libraries.

Phase I: Define a detailed specification for the new tool or technology to be developed. Describe new and innovative ideas which will provide new capabilities for MCM test. Demonstrate the feasibility of key elements of the approach as necessary. Develop a plan to demonstrate the utility of this capability in collaboration with an end user. Prepare a business plan to ensure commercial availability.

Phase II: Develop and demonstrate the prototype defined in Phase I.

DARPA 93-015 TITLE: Support Structures for Field Emission Display Devices

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Identify new materials or processes that can be used to fabricate spacers for field emission displays.

DESCRIPTION: Field emission displays require some form of structures to support the face plate of the displays device. These support structures must be compatible with the high electric field and high vacuum operating conditions of the display. Furthermore, their manufacturing process must be affordable and compatible with other display components.

Phase I: Identify support structure materials and develop fabrication process steps.

Phase II: Prepare sample structures and test under simulated operating conditions.

DARPA 93-016 TITLE: Method for Stimulating Hardware-in-the-Loop in a Distributed Simulation Environment

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Insert hardware components into man-in-the-loop distributed simulation, and thereby eliminate the assumptions inherent in any software models of those components.

DESCRIPTION: Distributed Interactive Simulation (DIS) and SIMulation NETworking (SIMNET) are gaining widespread acceptance for use in military training. These simulation tools are equally attractive for use in research and development and in the acquisition process. Distributed simulation for acquisition is desirable because of the ability of the user to participate throughout the design process and to directly influence the final form of the system being developed. However, the fidelity required for R&D applications is generally of a much higher quality than that required for training applications. That is, for R&D purposes, it is usually necessary to model all features and performance characteristics of the product being developed if any meaningful sensitivity analyses or trade-off analyses are to be performed. However, for training purposes, it is merely sufficient if realistic cues are presented to the man-in-the-loop to elicit some desired behavior. In most cases, the fundamental physics of the underlying processes are modeled only very crudely - if at all - and then only to the degree required to produce the desired human response. As a result, the validity of these simulations for R&D purposes is often questioned.

One solution to the problem of validity of DIS for R&D is to incorporate validated models into the underlying software. A more attractive approach, and the subject of this solicitation, is to incorporate actual hardware into the simulation thereby eliminating the need for any software model of the component's performance. The hardware must be stimulated by the simulation environment, respond, and interact appropriately with the simulation environment. As additional hardware components are designed and fabricated, they too could replace their respective software models. As the percentage of hardware components in the simulator increases, the overall system performance can be more confidently assessed because it more closely approximates the final product.

Phase I: Prepare a concept for incorporating hardware components into SIMNET-like simulators so that their built-in performance algorithms may be utilized instead of using software models to approximate performance. Implementation concepts should be compatible with the evolving DIS Standards and Communications Protocols. For the purposes of this solicitation, hardware components of the following types should be considered: sensors, seekers, and guidance and control devices.

Phase II: Demonstrate the concept by embedding a Government-Furnished Equipment (GFE) hardware component(s) into the SIMNET simulator and validate its (their) performance in comparison with that of the software model(s) the component(s) replace(s).

DARPA 93-017 TITLE: Method for Incorporating High-Fidelity Engineering Models into Distributed Simulations

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Insert high-fidelity engineering and physics models into man-in-the-loop distributed simulations, and thereby improve the overall validity of weapon system performance modeling.

DESCRIPTION: Distributed Interactive Simulation (DIS) and SIMulation NETworking (SIMNET) are gaining widespread acceptance for use in military training. These simulation tools are equally attractive for use in research and development and in the acquisition process. Distributed simulation for acquisition is desirable because of the opportunity afforded to the user to participate throughout the design process and to directly influence the final form of the system being developed. However, the fidelity required for R&D applications is generally of a much higher quality than that required for training applications. That is, for R&D purposes, it is usually necessary to model all features and performance characteristics of the product being developed, if any meaningful sensitivity analyses or trade-off analyses are to be performed. However, for training purposes, it is sufficient if realistic cues are presented to the man-in-the-loop to elicit some desired behavior. In most cases, the fundamental physics of the underlying processes are modeled only very crudely - if at all - and then only to the degree required to produce the desired human response. As a result, the validity of these simulations for R&D purposes is often questioned. One solution to the problem of validity of DIS for R&D is to incorporate validated models into the underlying software. Engineering and physical models of system performance are expressed in a variety of forms but are usually reducible to a set of state equations which characterize system performance in terms of the interrelationships of the state variables of interest. Because the procedure for validating such models is clearly defined, using them is a straightforward solution to the problem of validating distributed simulation for R&D.

Phase I: Prepare a concept for incorporating high-fidelity system performance models into SIMNET-like simulators. Implementation concepts should be compatible with the evolving DIS Standards and Communications Protocols and should be generic so as to allow for the widest variety of commonly used approaches to system performance modeling. For the purposes of this solicitation, performance of components of the following types should be considered: sensors, seekers, guidance and control devices, engine and drivetrain.

Phase II: Demonstrate the concept by embedding a validated, high-fidelity software model of a hardware component into SIMNET software, and assess the resulting performance.

DARPA 93-018 TITLE: Develop a Generic Graphic Modeling Tool for Generating Detailed Missile Fly-Out Trajectory Analysis

CATEGORY: 6.1 Basic Research

OBJECTIVE: Develop a graphical tool for animating missile simulation and/or flight test data.

DESCRIPTION: The advances in the graphical hardware have made it possible to develop low cost graphical analysis tools for animating events of interest in missile simulations and flight tests. Typically, static 2-D line and 3-D surface plots are used to analyze simulation and flight test data. By adding the 4th dimension of time, and being able to visualize "real world" images, the analyst's perception of these events is enhanced.

Phase I: Define the graphical model and trajectory input file formats, and develop a tool to perform the following tasks: playback of simulation and/or telemetry data; reconstruction of sensor field of view; and, playback of multistage/multibody separation events.

Phase II: Develop a graphical user interface and incorporate peripheral hardware devices to control playback sequences. Expand software to include: multiple missiles/targets; sensor imagery such as detector scenes, display of track gates, and field of regard; and development of a multiple window environment for viewing several scenes simultaneously.

DARPA 93-019 TITLE: Development of Non-Liquid Host Dye Laser Concepts

CATEGORY: 6.1 Basic Research

OBJECTIVE: Provide improved dye lasers. By impregnating the laser dyes in a suitable solid host material, issues such as solvent flammability, toxicity, and dye carcinogens may be minimized. This will also cut the total system weight and

complexity by as much as 50% - 70%.

DESCRIPTION: The focus of this topic is to identify prospective host materials and manufacture solid state dye laser rods and slabs. The candidate host materials should allow homogenous dye impregnation, minimize lensing and distortion effects, be transmissive in the laser dye absorption and fluorescence bands, and be inclusion/bubble free down to <0.1 microns. The processes involved in manufacturing the laser rods or slabs will be chosen in a manner which would not damage the dye molecule. The identification of host material other than plastics (e.g. Poly Methol Methacrylate (PMMA), Poly Carborate (CR-39)) is encouraged.

Phase I: The initial phase of this effort is to include investigation of the host materials. Different casting techniques, absorption and fluorescence curves of the undoped host, dye solubility, and possible limitations on rod diameter and length, as well as slab thickness and length will be investigated. Feasibility of casting host material against parallel (<1 minute of arc) optical flats which would relieve the need for optical polishing will be addressed. Also, the possibility of applying anti-reflective or laser resonator coatings directly on the host material will be examined in this phase.

Phase II: Phase II includes manufacture of solid state dye laser rods and slabs. The information gained from Phase I will be applied in Phase II in an effort to achieve optimum quality dye laser rods and slabs. The dye laser rods and slabs shall be doped with, but not limited to, the following laser dyes: 1.) Sulforhodamine 640, (2) Rhodamine 590 chloride, and (3) Rhodamine 590 Tetrafluoroborate. At least one of the Pyrromethene - BF_2 - complexes (Exiton Laser Dye: pyrromethene 546, 556 or 567), (4) Coumarin 540, (5) Coumarin 314, (6) Coumarin 102 and, (7) undoped. If feasible, the following sizes of dye laser rods will be cast: (1) 10.0 mm x 380.0 mm, (2) 10.0 mm x 500.0 mm, and (3) 25mm x 660 mm. The slabs will be 150.0 mm x 5.0 mm x 20.0 mm if possible. The concentrations may require adjustments in order to achieve uniform pumping.

DARPA 93-020 TITLE: Increased Field of Regard (FOR) Techniques for Staring Infrared Focal Plane Arrays (IR FPA)

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Investigate and develop innovative optical scan mechanisms and techniques for large search FOR, for IR FPA.

DESCRIPTION: Large area staring IR FPAs in both Medium Wavelength Infrared (MWIR) and Long Wavelength Infrared (LWIR) are a developing technology and are under consideration for several future applications in missile guidance. The 2-D focal plane array "stares" at the target without a scanning mechanism and generates a high quality, rectilinear data sample of the target and background scene. The current disadvantage to the utilization of the staring sensor is, that unless very large and expensive FPAs are utilized, the search or acquisition Field of View (FOV) is very small, and limited by the staring FPA (i.e., looking through a soda straw). To improve the performance of the FPA for these applications, a mechanism for scanning the staring FOV in a larger search volume is needed so that this 2-D FPA technology can be useful to the developing concepts involving wide area search. Two approaches are immediately known that can address this problem. A conventional optical wedge scanner operating with a gimbal scan can be configured to search the FPA FOV over a large area with periods of low or zero spatial velocity so that the FPA can be "framed." (Data must be collected at low velocity to avoid image smear.) Another more innovative and progressive approach is to utilize two lenslet plates of binary optics with a micro shifting mechanism. Small motion of these plates may cause large shifts in the FOV of an IR FPA located behind the plates. Since only small relative motion of the plates is necessary, a programmable or controlled search regime may be possible. Other techniques for increasing the FOV of IR FPAs will be investigated in Phase I.

Phase I: Provide detailed analysis of at least two different conceptional designs, through a preliminary design and performance prediction effort.

Phase II: Develop hardware and perform laboratory demonstrations to verify the most promising technical approach.

DARPA 93-021 TITLE: Processing Technology Development for the Manufacturing of Optoelectronic Integrated Circuit Modules

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Packaging Methods and Approaches for Optoelectric Integrated Modules are being solicited. The module

should be clearly identified in intended functions and capabilities.

DESCRIPTION: Optical/Optoelectronic modules are being developed to perform critical functions in information processing systems. These modules generally consisted of optical, optoelectronic components. The preferred embodiment of the modules is a self-contained, compact unit with mechanical and thermal stability. The packaged product must provide compatible optical and electrical inputs/outputs. The extra capabilities of the modules are often achieved by temporal, spatial, or wavelength multiplexing, coherent detection, optical routing, and switching, etc. The exacting requirements of optical alignment, in addition to high speed electronics, represents a considerable degree of complexity. This solicitation seeks ideas and methodology in packaging of integrated optoelectronic modules. While each functional module will probably require individualized solution, suitable extension of the particular solution to general methods should be considered. Generic approaches are also being solicited.

Phase I: Outline concept. Identify major technical barriers. Demonstrate feasibility in overcoming the barriers.

Phase II: Demonstrate and deliver the assembled hardware.

DARPA 93-022 TITLE: All-Dry Photoresist and Wafer Cleaning Techniques

CATEGORY: 6.1 Basic Research

OBJECTIVE: Develop and demonstrate dry alternatives to conventional wet photoresist and wafer cleaning processes which can be implemented in a semiconductor manufacturing environment.

DESCRIPTION: The fabrication of ultra large scale integrated circuits (ULSI) has grown to include hundreds of process steps with a significant number of wet etch steps for metal and organic contamination removal and many wet photoresist steps for pattern definition. The replacement of these conventional steps with all-dry processing could offer significant reductions in the total number of process steps as well as improvements in defect reduction, process control, and waste disposal. This implementation would eventually result in improvements in yield and manufacturing cost, and is the goal of this program. This program will consist of a task for dry processing for pattern definition and a task for wafer cleaning. The photolithography task will consider material systems for use with 193-nm and x-ray exposure tools for geometries below 250 nm. In particular, top surface imaging (TSI) material systems are of interest. These include positive and negative tone silylation resists and bilayer schemes which can be dry deposited and developed. In addition, deposited inorganic resist systems will be considered for extended application to x-ray exposure. The wafer cleaning task will explore the removal of metal and organic surface contaminants by dry process techniques. In particular, laser assisted particle removal (LAPR), CO_2 and hypersonic gas jet cleaning all have shown initial capability to remove surface contaminants, and will be considered. The selected approach should demonstrate initial feasibility with a low risk approach to commercial implementation in a semiconductor manufacturing environment.

Phase I: Study and demonstrate the initial feasibility of all dry patterning and wafer cleaning techniques for ULSI semiconductor manufacturing. In particular, provide initial process performance, yield, and manufacturing cost estimates. Develop a commercialization plan for the selected approach.

Phase II: Demonstrate a prototype process (or sub-process) using all dry patterning and wafer cleaning techniques for ULSI semiconductor manufacturing.

DARPA 93-023 TITLE: In-Situ Non-Destructive Inspection of Ultra Large Scale Integrated (ULSI) Wafers

CATEGORY: 6.1 Basic Research

OBJECTIVE: Develop and demonstrate approaches for the in-situ inspection of wafer level physical and electrical performance parameters.

DESCRIPTION: The fabrication of ultra large scale integrated (ULSI) circuits has grown to include hundreds of process steps with a significant number of ex-situ inspection steps. This inspection approach is quite costly, results in probe/handling related yield loss, and does not offer a mechanism for real-time process control. This program will develop a new class of non-destructive inspection tools which will extract wafer level physical and electrical performance parameters through in-situ measurements. The two candidate tools of near term interest are a non-contact test station for single wafer measurements of linewidth, overlay, and device electrical parameters, and a high resolution imaging system for pattern

inspection. The proposed approaches should demonstrate initial feasibility with a low risk approach to commercial implementation in a semiconductor manufacturing environment.

Phase I: Develop an approach for a prototype in-situ inspection system and predict its performance and Cost of Ownership (COO) using the SEMATECH COO (or similar model). Develop a commercialization plan for the tool.

Phase II: Develop and demonstrate a prototype in-situ inspection system which has performance and COO benefits over existing systems and which provides an interface for real-time process control.

DARPA 93-024 TITLE: Point-of-Use Generation and Disposal of Wafer Process Chemicals

CATEGORY: 6.1 Basic Research

OBJECTIVE: Develop a new class of semiconductor process chemistry and supporting equipment for point-of-use generation, reaction, and disposal of reactants.

DESCRIPTION: The fabrication of ultra large scale integrated (ULSI) circuits relies upon multiple process steps involving numerous chemical reactions. Many of the process chemicals which are used in significant volume, such as AsH3, PH3, B2H6, HCL, and HF, are highly toxic, require costly containment, distribution, and disposal support, and have significant particle contamination. This program will develop new process chemistries, advanced filters, and gas distribution and disposal hardware for integration into a point-of-use system. The process chemistry task will develop a new class of designer precursor molecules which will enable process gases to be locally synthesized from liquid sources with higher purity than conventional means. Initial demonstrations to date have identified organo-silicone precursors for AsH3, PH3, and B2H6. Improvements upon these and extensions to other process chemistries used in the semiconductor industry will be considered. The remaining two tasks will address components for point-of-use filtration of corrosive gases using absolute and absorption media, improved components for toxic gas disposal, and low-cost mass flow controllers for integration into point-of-use process systems.

Phase I: Identify and demonstrate initial chemistries or components which can be integrated into a point-of-use process. Develop a commercialization plan for the technology developed in Phase I.

Phase II: Demonstrate the chemistries or components developed in Phase I in a point-of-use process.

DARPA 93-025 TITLE: Hybrid Image Understanding (IU)/Neural Net (NN) Techniques for Target Recognition and Multisensor Fusion

CATEGORY: 6.1 Basic Research

OBJECTIVE: Combine the best capabilities of IU and NN techniques, in a complementary way, to obtain performance results in target recognition and multisensor fusion beyond that obtainable using these fields individually.

DESCRIPTION: Image understanding techniques make effective use of "world knowledge" such as map or collateral information, but are slow in performing specific image classifications. Neural network techniques are fast in classification, but are awkward for encoding symbolic information. Innovative research efforts are sought for developing hybrid IU/NN systems that demonstrate the power of combining the two technologies. The systems developed must incorporate sophisticated, well-developed techniques in both image understanding and neural networks, and must demonstrate a nontrivial synergistic usage of the two technologies. The systems developed must address specific target recognition and/or multisensor fusion tasks. Preference will be given to proposals with potential for near-term transition to DoD systems, and for which training and testing data are readily available.

Phase I: Develop concepts for hybrid IU/NN target recognition and multisensor fusion, and carry out computer simulations to verify their efficacy.

Phase II: Develop a demonstration system applied to a specific problem in target recognition and/or multisensor fusion.

DARPA 93-026 TITLE: Semantic Search of Information Database

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Determine how to use a large semantic network to improve database searches.

DESCRIPTION: Many information retrieval systems rely on keyword searches; some rely on statistical techniques. The former is susceptible to human limitations in selecting appropriate sets of keywords, and Boolean formulas; the latter, to characteristics of the corpora from which statistical weights are derived. It may be possible to improve the performance (i.e., recall and precision) of either or both approaches by taking advantage of the information encoded in large semantic networks. One likely candidate is Princeton's WordNet, a lexical resource which represents the major semantic relations in human memory (e.g., synonymy, hyponymy, meronymy, antonymy). DoD has supported the development of WordNet. Information about obtaining WordNet and associated reports by File Transfer Protocol (FTP) can be obtained by communicating with wordnet@clarity.princeton.edu.

Phase I: Determine how database searches could be improved, automatically or interactively, using WordNet. Perform a limited proof-of-concept.

Phase II: Extend and enhance the techniques explored in Phase I. Develop an interface to a significant database (e.g., Defense Technical Information Center) and conduct an extensive test measuring performance differences with and without those techniques.

DARPA 93-027 TITLE: Voice Authentication Monitoring System

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Explore novel techniques for monitoring and making decisions about a speech signal to ascertain that the speaker is the person he or she claims to be, and has not, during the course of the conversation, been replaced by an impostor.

DESCRIPTION: Concepts are sought for novel signal-processing and decision-making techniques for parameterizing a speaker's voice, computing the change in those parameters both during a conversation and from a baseline set of parameters for the claimed speaker, and making a decision as to whether to terminate the conversation or allow it to continue. The techniques must accommodate normal voice changes over time and during a conversation, while being able to recognize that an impostor has either initiated or "hijacked" the conversation. The decision procedure must be sensitive to speaker change, yet not prematurely terminate valid conversations, as a consequence of repeated testing. It is anticipated that both the selection of an appropriate technique from competing ones, and the determination of operating parameters for a technique, will require empirical evaluation. Therefore, this exploratory development will include the design and implementation of a suitable system for the comparative evaluation of different signal-processing and decision-making techniques, and the design of a paradigm for making such an evaluation.

Phase I: Provide a conceptual, mathematical and algorithmic description of the proposed techniques and a discussion of their novelty and advantages over current ones. Identify and explain the operational parameters for each technique. Provide a detailed specification of a system for demonstrating and evaluating the techniques.

Phase II: Implement the system and the techniques and perform tests for setting parameters and evaluating performance. Report on details of implementation not covered in the Phase I descriptions, and analyze the performance, particularly the source of errors. Include a copy of the code in the report. The magnetic-media copy of the code must be delivered in ASCII form, in the UNIX tar (tape archiver command) format.

DARPA 93-028 TITLE: Computational Sensors

CATEGORY: 6.1 Basic Research

OBJECTIVE: Develop computational sensors that incorporate computation at the level of sensing to increase their performance and achieve new capabilities that are not otherwise possible. Also required are algorithms that can utilize the output of such sensors.

DESCRIPTION: Computational sensors use nonstandard geometry and/or built-in computational capability to achieve new capabilities. An example of nonstandard geometry is a circular sensor having spatially varying resolution from a high resolution center (fovea) to a low resolution periphery, as in the human eye. An example of built-in computational capability is the "silicon retina," the California Institute of Technology chip based on the neural architecture of the eye. The research would involve development of computational sensors. Such algorithms are required because conventional image understanding algorithms are defined for sensors having rectangular arrays of picture elements.

Phase I: Construct or simulate a laboratory model of a computational sensor and/or several important image understanding algorithms for an existing computational sensor.

Phase II: Apply the computational sensor and/or the algorithms to an applied problem of interest including, but not limited to, object tracking. The domain of interest is unmanned vehicles or robotics.

DARPA 93-029 TITLE: Sensor and Algorithm Planning and Allocation for Use in Image Understanding

CATEGORY: 6.1 Basic Research

OBJECTIVE: Develop "task-oriented vision" (i.e., combined image understanding and planning techniques that allow sensors and algorithms to be treated as resources allocated to solve a vision problem).

DESCRIPTION: Task-oriented vision will endow a system with a flexible control structure for allocating and using only the resources necessary to answer the visual question of the moment to the desired level of detail or certainty. Under this control, vision modules or sensors of known characterisitics are sequentially brought to bear on selective areas of the scene. Their choice should depend on the results of previously executed modules or sensors. Each module produces a partial representation of the (minimal) information needed to answer the question, and this evidence is combined to produce a partial answer. The process continues until the partial answers are enough. Thus, a task-oriented vision capability can act as the cognitive executive for active vision.

Phase I: Develop the basic framework for a task-oriented computer vision system.

Phase II: Mechanize and deliver the task-oriented concepts as applied to an interesting machine vision problem related to unmanned vehicles or robotics.

DARPA 93-030 TITLE: Bubble-Based False Undersea Targets

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Mechanically provide/develop a volume for use in sea water which has a small void fraction of air within a contained sea water mass to be used as an undersea target.

DESCRIPTION: The object is to mechanically provide/develop a volume for use in sea water which has a small void fraction of air within a contained sea water mass to be used as an undersea target. The properties of this air volume are such that an acoustic echo will be reflected when the volume is ensonified by an underwater acoustic signal. The void reaction might be realized by air in small tubes, a pump circulating water with minute amounts of air entrained within a bladder, a gelatin-like mix of sea water and air, or other ideas. The objective is low cost, easy handling, flexibility, and simplicity of maintenance and deployment operations. A detailed study of acoustic behavior is not desired, as this is mostly understood and can be modeled. A simple low cost means to create and maintain the bubble target is desired.

Phase I: Provide/Develop proof-of-principle design and small scale experiment

Phase II: Design, fabricate, and test acoustic bubble-based target

DARPA 93-031 TITLE: Intelligent, Modular, Scalable Controllers and Actuators for Use in Automated Systems

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Develop and demonstrate intelligent, modular, scalable electro-mechanical and fluid-mechanical controllers and actuators for automation system applications.

DESCRIPTION: There is a need to develop intelligent controllers and actuators for automated mechanical systems. Both new applications and upgrade applications will require automation with distributed intelligent controllers and actuators. Systems are required that are both modular and extendable in both software and hardware and that can utilize alternative control and actuation strategies. In the future, distributed automated machinery will require local intelligent modes where sensing, signal processing, data fusion, state reasoning, controllers, and end effect actuators will be collocated and scalable to facilitate use on classes of machine automation. This is a new field that requires interdisciplinary expertise.

Phase I: Develop a conceptual design for intelligent controllers and actuators. Demonstrate subscale concept feasibility of the selected design. A trade-off analysis with appropriate metrics is required.

Phase II: Design and demonstrate a full-scale prototype of a representative class of intelligent, scalable, modular controllers and actuators. Conduct performance and cost sensitivity analysis to demonstrate viability of concept.

DARPA 93-032 TITLE: Synthetic Dolphin Blubber Compliant Coatings

CATEGORY: 6.2 Exploratory Development

OBJECTIVE: Develop synthetic materials based on the viscoelastic properties of live dolphin blubber to act as a compliant coating for underwater vehicles to reduce drag as well as noise. No experimentation with live dolphins will be conducted as part of this effort.

DESCRIPTION: The dolphin has a remarkable skin and blubber which minimizes both drag and flow noise. Recent studies of fast swimming dolphins in sea water show little phosphorescent activity due to the reduced turbulent boundary layer. Recent materials investigations have shown the unusual properties of the blubber. The purpose of this task is to synthesize the material so it will exhibit properties similar to those of live dolphin blubber.

Phase I: Develop, fabricate, and test synthetic blubber materials. Examine candidate coatings and measure viscoelastic properties. Three coatings will be selected for full-scale tests.

Phase II: Fabricate, install, and test the coatings developed in Phase I on undersea vehicles approximately 36 feet in length and 44 inches in diameter.

DEFENSE NUCLEAR AGENCY

Submission of Proposals

The Defense Nuclear Agency is seeking small businesses with a strong research and development capability and experience in nuclear weapon effects, phenomenology and operations. (Note: we are not interested in nuclear weapon design or manufacture.) DNA invites the small business community to send proposals directly to the following address:

Defense Nuclear Agency
ATTN: AM/SBIR
6801 Telegraph Road
Alexandria, VA 22310-3398

The proposals will be processed, then distributed to the appropriate technical office for evaluation. Questions concerning the administration of the SBIR program and proposal preparation should be directed to:

Defense Nuclear Agency
ATTN: AM, Ms. P. Brooks
6801 Telegraph Road
Alexandria, VA 22310-3398
Tel: (703) 325-5021

DNA had identified 20 technical topics, numbered DNA 93-001 through DNA 93-020, to which small businesses may respond in this solicitation (93.1). Please note that these are the only topics for which proposals will be accepted. The current topics and the full topic descriptions are included below. These topics were initiated by DNA technical offices which manage the research and development in these areas. Note several of the topics are intentionally broad to ensure any innovative idea which fits within the mission of DNA may be submitted. Proposals do not need to cover all aspects of these broad topics. Questions concerning the research topics should be submitted to:

Defense Nuclear Agency
ATTN: OTA, Mr. James M. Gerding
6801 Telegraph Road
Alexandria, VA 22310-3398
Tel: (703) 325-1217

DNA selects proposals for funding based upon technical merit, criticality of the research, and evaluation criteria contained in this solicitation document. As funding is limited, DNA reserves the right to select and fund only those proposals considered to be superior in overall technical quality and most critical. As a result, DNA may fund more than one proposal in a specific topic area if the technical quality of the proposals are deemed superior; or it may fund no proposals in a topic area. Proposals which cover more than one DNA topic should only be submitted once.

Subject Index to the DNA SBIR Solicitation

DEFENSE NUCLEAR AGENCY

FY 1993 SBIR TOPIC INDEX

DEFENSE NUCLEAR AGENCY
FY 1993 SBIR TOPIC DESCRIPTION

DNA 93-001 TITLE: Nuclear Weapon Effects Calculation

CATEGORY: Exploratory Development

OBJECTIVE: Improve the accuracy, runtime, or visualization of output of nuclear weapon effects calculations.

DESCRIPTION: Accurate and efficient calculation of nuclear weapon effects and display/presentation of such calculations are of major concern to DNA. Areas of interest include more accurate calculations, faster running calculations, desktop versions (where appropriate) to enable use by a wide audience, and new and improved ways to enable users (be they advanced nuclear weapons effects researchers, weapon systems developers, or managers with limited nuclear weapons effects experience) to calculate, estimate, and appreciate nuclear weapon effects and the survivability/ vulnerability of structures and equipment to these effects. Nuclear weapon effects include airblast; ground shock; water shock; cratering; thermal radiation; neutron, gamma and x-ray radiation; electromagnetic pulse; fallout; blueout; blackout; redout; dust cloud formation; and the effects of these on personnel, materials and structures. Structures of interest include deep underground, land-based, sea-based, and aerospace structures.

During Phase I, the research will demonstrate the feasibility of the proposed methodology to calculate and display/present nuclear weapon effects and/or the response of materials and structures to these effects.

During Phase II, the research concepts developed in Phase I will be further developed where, if appropriate, the concepts will be incorporated into appropriate codes.

DNA 93-002 TITLE: Response of Materials to Nuclear Weapon Effects

CATEGORY: Exploratory Development

OBJECTIVE: Measure the response of new and existing materials to nuclear weapon effects and develop methods to improve the survivability of these materials.

DESCRIPTION: Of interest to DNA is the response of materials, structures, and systems to nuclear weapons effects. Materials of interest include metals, ceramics and composites. New materials capable of being used as a structural members for aircraft, missiles, ships, submarines and military vehicles are of particular concern. The response of underground structures such as missile silos, command and control facilities and communications facilities are especially important. Concepts and techniques which will improve the survivability (decrease the response) of these types of systems to nuclear weapons effects are required.

New materials with enhanced electromagnetic shielding properties are also of interest.

During Phase I, testing plans and feasibility studies on the material will be completed.

During Phase II, the material will be tested and conclusions from the test results will be drawn.

DNA 93-003 TITLE: Nuclear Weapon and Neutral Particle Beam Effects on Electronics and Communications

CATEGORY: Exploratory Development

OBJECTIVE: Explore the effects of nuclear weapon explosions on electronics and communications.

DESCRIPTION: The nature and magnitude of the effects produced by the interaction of nuclear weapon produced radiation on electronics, electronic systems, opto-electrical devices, sensors, and communication systems in the phenomenology areas of a)

Transient Radiation Effects on Electronics (TREE); b) Electromagnetic Pulse (EMP); c) System Generated EMP (SGEMP); and d) atmospheric effects (blackout, redout, etc.) are of interest to DNA. Particular areas of concern include; methods by which designers of space, strategic and tactical systems can assess their susceptibility to these effects; technologies to reduce the susceptibilities of electronic systems and devices (especially those with submicron feature sizes) to acceptable levels; and methods to demonstrate survivability under specified threat criteria. Concepts and techniques to improve the survivability (decrease the response) of systems against these nuclear weapons effects are required.

During Phase I, initial feasibility studies will be completed to demonstrate the viability of the proposed approach.

During Phase II, continue the investigate began in Phase I to fully develop the proposed approach.

DNA 93-004 TITLE: Nuclear Weapon Effects Simulation

CATEGORY: Exploratory Development

OBJECTIVE: Improve the state-of-the-art in nuclear weapon effects simulation.

DESCRIPTION: Simulators are needed to: (1) provide experimental data for development of numerical simulations of nuclear weapons effects; (2) simulate one or more nuclear weapons effects at laboratory size scale; (3) predict what will occur during an underground nuclear test; (4) calibrate gauges used in the large scale simulators; (5) develop new gauges; and (6) dust lofting tests (centrifuges).

Simulation requirements include airblast over various surface conditions, dusty flow, dust lofting, shock propagation in rock, water shock, thermal radiation, EMP, and nuclear radiation.

Existing large scale simulators are often expensive and time consuming to operate, and require travel to an explosive test site. Small scale simulators are needed to provide extensive data to supplement the limited amount of data available from the large scale simulators. Innovative simulators are needed which are economical and simple to operate. Innovative ideas are needed on how to use very small scale simulators to produce useful information. A joint proposal with a government laboratory may be helpful because the simulator can then remain at the government laboratory where it will be readily available for future use.

During Phase I, build the basic simulator and demonstrate that it functions properly.

During Phase II, use the simulator to produce useful data and improve the simulator as necessary.

DNA 93-005 TITLE: Instrumentation

CATEGORY: Exploratory Development

OBJECTIVE: Develop new instrumentation or improve existing instrumentation used in nuclear weapon effect simulators and in underground nuclear testing.

DESCRIPTION: Instrumentation is used for measuring nuclear weapon effects, phenomenology parameters, the response of test items exposed to real or simulated nuclear weapon effects and control of advanced accelerators used to simulate weapon effects. The instrumentation should be capable of operating under very harsh conditions, such as might be encountered in underground nuclear tests, high explosive tests, or tests involving high levels of x-ray, gamma, or neutron radiation. Instrumentation is needed for the following types of tests: airblast, dusty flow, dust lofting, water shock, shock propagation in rock, HE, nuclear radiation thermal radiation and underground nuclear tests and for data acquisition. Desirable improvements in capability include improved reliability, ease of operation, ease of calibration (preferably on site) and improved maintainability.

During Phase I, build a prototype instrument or instrument system and demonstrate its performance in laboratory tests.

During Phase II; design, build, and test a full scale instrument system demonstrating its performance in its intended working

environment. This may involve coordination with DNA to schedule testing in a simulator or underground nuclear test.

DNA 93-006 TITLE: Structural Response to Nuclear Weapon Effects

CATEGORY: Exploratory Development

OBJECTIVE: Improve the design and hardness assessment of structures to nuclear weapons effects.

DESCRIPTION: Improved designs of hardened structures are needed as well as a better understanding of failure mechanisms of structures. Type of structures include deep underground, land-based (fixed and mobile), sea-based (floating and submerged) and aerospace structures. Designs are needed to resist conventional as well as nuclear weapons effects. Improved methods are needed for analysis and model testing of structures to large deflection and collapse damage levels.

During Phase I, the research will demonstrate the feasibility of the proposed designs/methodology to determine structural response to nuclear weapon effects.

During Phase II, the research concept developed in Phase I will be further developed where, if appropriate, the concepts will be incorporated into other existing methodology/codes.

DNA 93-007 TITLE: Nuclear Hardening and Survivability

CATEGORY: Exploratory Development

OBJECTIVE: Develop techniques to improve the nuclear hardening and survivability of defense systems.

DESCRIPTION: Techniques for nuclear hardening and survivability of systems, structures, or personnel against nuclear weapons effects are required. These techniques should protect the structure or system against the combined effects of blast, thermal, nuclear radiation, and in the cases of structures or materials, and should also provide protection against electromagnetic and radiation effects wherever any electronic capabilities are involved. In particular, the ability to harden communications facilities and surveillance sensors against electromagnetic pulses is required. Systems include planned and operational strategic and tactical ground mobile systems, missiles, aircraft, spacecraft and their subsystems and components.

During Phase I, demonstrate the feasibility and usefulness of the proposed technique.

During Phase II, fully develop the proposed technique and characterize its usefulness in both technical and cost terms.

DNA 93-008 TITLE: Security of Nuclear Weapons

CATEGORY: Exploratory Development

OBJECTIVE: Improve the security of US nuclear weapons against all types of threats.

DESCRIPTION: Measures to improve the security of nuclear weapons against all possible threats are required. These methods are expected to include weapon storage facility designs, transportation facility designs, new security sensors and sensor system development, methods to improve the secure handling of nuclear weapons, and methods to improve the effectiveness and efficiency of nuclear weapon security operations. Proposals should describe how they will improve protection against known and predicted threats and should emphasize weapon concealment where appropriate.

During Phase I, demonstrate the feasibility and potential usefulness of the proposed security measures.

During Phase II, fully develop the proposed security measures so they can be compared to existing techniques.

DNA 93-009 TITLE: Theater Nuclear Forces (TNF) Survivability

CATEGORY: Exploratory Development

OBJECTIVE: Improve the survivability of US nuclear weapons.

DESCRIPTION: The prelaunch survivability (PLS) of the TNF is of vital concern. New and innovative concepts to improve PLS are needed to retain a viable nuclear strike capability and to enhance deterrence. The threats to the TNF include enemy forces conducting unconventional, conventional, chemical and nuclear warfare during periods of peacetime, transition to war, and war. Long range program thrusts include peacetime and field storage, deceptive/OPSEC practices, theater nuclear force movements, and operational survivability of theater nuclear systems (aircraft, missiles, and cannon systems). Survivability concepts are warranted for the period of the 1990's and beyond. Concepts should employ innovative ideas and make use of new and emerging technologies.

During phase I, demonstrate the feasibility and potential usefulness of the proposed survivability measures.

During Phase II, fully develop the proposed survivability measures so they can be compared to existing techniques.

DNA 93-010 TITLE: Operational Planning and Targeting

CATEGORY: Exploratory Development

OBJECTIVE: Improve the ability of US nuclear commanders to plan for nuclear engagements and target their nuclear weapons.

DESCRIPTION: The nuclear employment planning capabilities of operational commanders in tactical, strategic and integrated warfare environments should be improved. Improvements desired include development of automated planning systems, techniques to determine target damage objective and criteria, post strike target damage assessment capabilities, and automated nuclear weapon employment codes. Techniques to account for electromagnetic effects in operational planning and exercises are also desired.

During Phase I, develop the proposed technique in sufficient detail to demonstrate its feasibility.

During Phase II, continue the development of the proposed technique to the point it can be incorporated into existing planning/targeting methodologies.

DNA 93-011 TITLE: Underground Nuclear Testing

CATEGORY: Exploratory Development

OBJECTIVE: Improve the design, execution, and evaluation of underground nuclear tests.

DESCRIPTION: Underground nuclear effects tests are used in situations for which no suitable above ground simulator exists. Areas of interest include improvements in the design and execution of tests (horizontal/vertical line of sight and cavity), the design of new experiments which extend the capability of current test beds, and innovative test concepts to meet future needs. To improve our understanding of the results improvements to the mathematical methods used to perform various calculations within the test design and analysis program are needed. New methods of characterizing existing materials which are used in critical portions of the test bed (such as the A box) and new materials for such applications, new approaches to the geological problems encountered in the construction of the test beds, and new methods for all test activities (excavation, fabrication, assembly in the tunnel complex, recording data, transmission of data) are also of interest to DNA.

During Phase I, demonstrate the feasibility of the proposed test/experiment improvement. This will be done using laboratory and/or above ground testing.

During Phase II, demonstrate the proposed techniques with underground nuclear testing and/or above ground testing.

DNA 93-012 TITLE: Verification Technology Development

CATEGORY: Advanced Development

OBJECTIVE: Improve/develop US technical capability to verify/ monitor compliance with existing and potential future arms control treaties and agreements, e.g., START, INF, CW, CFE, NTT, SNF, and Presidential Initiatives.

DESCRIPTION: New arms control measures are being negotiated which could drastically alter existing inventories of nuclear weapons. New verification technologies and methods will be required to accurately monitor compliance to the provisions of any treaties or agreements that could result from the on-going negotiations. The problem will basically involve being able to distinguish between permitted activities and prohibited activities where the technical signatures between the two could be very minor. New technologies and methods of monitoring proliferation of weapons are also required for possible future nonproliferation agreements.

Phase I: Demonstrate the feasibility of the proposed technology in relation to a specific arms control application.

Phase II: Develop a proof of design to demonstrate the proposed technology.

DNA 93-013 TITLE: Nuclear Weapon Effects on Propagation

CATEGORY: Exploratory Development

OBJECTIVE: Investigate the effects of nuclear weapon explosions on radio signals and the subsequent performance of communication and radar systems. Investigate the effects of nuclear weapon created optical clutter backgrounds on optical sensor systems.

DESCRIPTION: The Defense Nuclear Agency is interested in the basic physical processes which describe the interaction of nuclear weapons with the atmosphere, which create environments that degrade the propagation of communication and radar signals and that contain optical clutter backgrounds which degrade optical sensor systems. Part of DNA's mission is to predict effects on and determine mitigation methods for DoD systems such as satellite communications, VLF/LF communications, HF/VHF communications, radar systems, and optical sensor systems. Areas of interest include mechanisms for the coupling of nuclear weapon energy to the atmosphere; the development of structure in weapon produced plasmas and molecular emitters; the chemical processes which give rise to the optical emissions; the transport and final deposition of nuclear debris; the effects of degraded signal propagation on the performance of communication systems and radars; and the prediction of the effects of optical clutter backgrounds on the performance of optical sensor systems.

During Phase I, demonstrate the feasibility of the proposed investigation to advance the understanding in any of the areas described above.

During Phase II, continue the investigation to the development of a product or results that can be incorporated into the existing technology base.

DNA 93-014 TITLE: Tactical Application of Pulsed Power Technology

CATEGORY: Exploratory Development

OBJECTIVE: Development of new applications of existing pulse power technology.

DESCRIPTION: Recent advances in energy storage and switching now make possible the application of DNA pulsed power technology to such areas as armor/anti-armor; electromagnetic/electrothermal guns; mine-countermine; air, surface, and subsurface systems; high power microwave weapons; etc. Concepts proposed should be highly innovative and make full use of the emerging pulse power technology.

During Phase I, demonstrate the feasibility of the proposed pulsed power application.

During Phase II, continue the development of the concept to an engineering model and conduct tests of the effectiveness of the idea.

DNA 93-015 TITLE: Advances in Pulsed Power Technology

CATEGORY: Exploratory Development

OBJECTIVE: Dramatic Improvements in energy storage, switching, and power conditioning state of technology

DESCRIPTION: Future requirements for systems employing pulsed power will necessitate improvements in efficiency, energy density, reliability, repeatability and overall performance. Innovative approaches for component or subsystem development are sought to meet future demands for radiation simulators and other pulsed power applications. Examples include more efficient pulse forming technologies, high energy density capacitors, more efficient insulators, improved and more reliable switching technologies, and improved power flow electrical circuit models. Pulsed power applications include operation at kilovolts to megavolts, kiloamperes to megaamperes, and repetition rates from single pulse to 10 kilohertz.

During Phase I, demonstrate the feasibility of the proposed concept.

During Phase II, develop, test, and evaluate proof-of-principle hardware.

DNA 93-016 TITLE: X-Ray Source Development

CATEGORY: Exploratory Development

OBJECTIVE: Innovative concepts for the production of x-ray radiation used in nuclear weapon effects testing.

DESCRIPTION: Future requirements for x-ray nuclear weapon effects testing will require vast improvements in existing radiation source capability as well as new concepts for producing soft x-rays (1-5 kev), warm x-rays (5-15 kev), and hot x-rays (>15 kev). Soft x-rays are used for optical and optical coatings effects testing. Warm x-rays are used for thermomechanical and thermostructural response testing; and hot x-rays are used for electronics effects testing. The proposer should be familiar with the present capability to produce x-rays for weapon effects testing.

During Phase I, demonstrate the feasibility of the proposed concept.

During Phase II, develop, test, and evaluate proof-of-principle x-ray source capability.

DNA 93-017 TITLE: Response of Insitu Rocks to Nuclear Weapons Effects

CATEGORY: Exploratory Development

OBJECTIVE: Development of methods to measure material properties of insitu rock and the incorporation of this data in ground shock/ground motion models.

DESCRIPTION: Techniques are required to measure the stress history that corresponds to a spherically diverging stress wave in medium-strength rock. The transducer must survive long enough to measure the stress history through the positive phase for peak radial stresses between 0.2 and 2.0 kbar (20 and 200 MPa).

During Phase I, conduct feasibility analyses to demonstrate viability of the proposed with special emphasis on sedimentary rocks.

During Phase II, implement the proposed techniques small scale field explosive experiments.

DNA 93-018 TITLE: Directed Energy Effects

CATEGORY: Exploratory Development

OBJECTIVE: Investigate the effects of directed energy and identify materials which may survive effects of directed energy weapons.

DESCRIPTION: The effects of directed energy sources on materials, structures and systems are of interest to DNA. Of particular interest is the establishment of the correlation between nuclear weapons effects and directed energy effects, the identification of materials which are capable of withstanding both nuclear weapons effects and directed energy effects, and mechanisms by which the directed energy sources actually interact with target materials/structures.

During Phase I, demonstrate the feasibility of the proposed investigation.

During Phase II, characterize the effects of directed energy on materials, structures, etc.

DNA 93-019 TITLE: Debris Mitigation

CATEGORY: Exploratory Development

OBJECTIVE: Develop advanced means of delaying, mitigating, and eliminating debris created from radiation sources in Above Ground Test (AGT) radiation simulators.

DESCRIPTION: Present Plasma Radiation Source (PRS) x-ray sources generate copious amounts of debris (material, atomic charged particles, sub-KeV photons). Debris production will become an even greater concern for the fluence levels of simulators currently under development. Analytical analysis is required to ascertain and characterize the source and nature of debris generated from wire array and z-pinch PRS sources in order to better understand debris sources and mitigation. Existing debris shield systems must be improved to support larger exposure areas and cleaner test environments while minimizing fluence degradation. New methods, or combination of methods, need to be developed to stop, mitigate, and/or delay debris generated for DECADE class radiation simulators.

During Phase I, demonstrate the feasibility of the proposed concept.

During Phase II, develop, test, and evaluate proof-of-principle hardware.

DNA 93-020 TITLE: X-Ray Simulator Diagnostics

CATEGORY: Exploratory Development

OBJECTIVE: Develop innovative diagnostics for use in Aboveground Test (AGT) radiation simulators.

DESCRIPTION: Diagnostic systems are used to monitor, measure, record and analyze simulator machine performance, source output, and test asset response. Diagnostics are required for detecting, recording, and evaluating radiation sources for soft (< 10 KeV) and hard (> 10K KeV) x-rays. Plasma parameters within simulator sub-systems such as plasma opening switches and plasma sources used in radiation simulators. Test response diagnostics are required to measure the full time history of the radiation pulse across the breadth and width of the test asset as well as the response of the test asset during and after irradiation. Pulsed power diagnostics are required for accurate, in-situ measurement of voltages and currents within the various simulator subsystems in order to monitor and characterize simulator performance. Diagnostic systems include required sensors/detectors, cabling, recording equipment and media, and, if necessary, computer systems and software.

During Phase I, design, build and test a prototype diagnostic system in a laboratory environment.

During Phase II, demonstrate the diagnostic system in its working environment on an AGT radiation simulator. This will involve coordination with DNA to schedule testing in a aboveground test simulator.

STRATEGIC DEFENSE INITIATIVE ORGANIZATION (SDIO)
SMALL BUSINESS INNOVATION RESEARCH PROGRAM
Submitting Proposals

Send Phase I proposals (five copies of the full proposal, PLUS three copies of Appendices A and B only) by US mail to:

Strategic Defense Initiative Organization
Attn: TNI/SBIR
Washington, D.C. 20301-7100

For Administrative Help ONLY: Call 800-937-3150

Proposals delivered by other means (commercial delivery service or handcarry) must be delivered to Room 1D110, The Pentagon, Washington, D.C. **WARNING: Only persons with access to the interior of the Pentagon building can reach Room 1D110. Delivery to a Pentagon entrance is not sufficient.** Receipt of proposals will be acknowledged only if the proposal includes a self addressed stamped envelope and a form (like Reference B) that needs only a signature by SDIO.

SDI is a DoD project to explore the feasibility of finding and disabling a ballistic missile in flight. Topics on the following pages broadly state SDI's interests. SDI seeks innovative technology that might enable a defense against a missile in flight. SDI seeks concepts for its need of lighter, faster, smarter, more reliable components. The proposer need not know details of possible SDI systems. SDI will also consider highly innovative technology that does not clearly fit into any specific topic.

SDI SBIR seeks a demonstrable product with a leap in capability. SDI seeks to invest seed-capital, to supplement private capital, in a product with a future market potential (preferably commercial) and a measurable SDI benefit. SDI SBIR will not fund ordinary research or studies, nor will it further develop concepts **already mature enough to compete** for venture capital or government development funds.

Phase I will show the concept feasibility and the merit of a Phase II for a prototype or at least a proof-of-principle. The development must be appropriate for a small firm. Principal Investigators who are tenured faculty are not considered primarily employed by a small firm if they receive compensation from the university while performing the SBIR contract. Any waiver must be requested explicitly with a justification showing a compelling national need. SDI expects to grant no waivers.

Because SDI seeks the best nation-wide experts in innovative technology, proposers may suggest technical reviewers by enclosing a cover letter with the name, organization, address and phone number (if known), and a rationale for each suggestion. Each must be a government employee. SDIO promises only to consider the suggestion with no commitment to heed it.

INDEX OF SDIO FY93 TOPICS

SDIO93-001 TITLE: Directed Energy Concepts

DESCRIPTION: Innovative applied research in the generation and propagation of directed energy beams. Systems being considered include (but are not limited to) chemical lasers, excimer lasers, laboratory x-ray lasers, gamma-ray lasers, free electron lasers, and hybrid approaches. Interests include the full range of embodiments, i.e., low mass spaced-based, ground-based, and pop-up systems. Included are such topics as weapon pointing, beam control, acquisition, tracking and pointing, mirrors technology, beam propagation through natural and disturbed environments, optics, and countermeasures.

SDIO93-002 TITLE: Kinetic Energy Weapons

DESCRIPTION: Kinetic energy (KE) weapons candidates presently include a variety of ground and space based interceptors including their propulsion. Approaches are sought which extend, facilitate, or reduce the cost of the concepts. System elements include ground-based launchers, divert motors/nozzles, smart projectile components, and endo/exoatmospheric guidance and control mechanisms. Technology challenges for KE systems include: the booster hardbody within the plume, high performance axial and divert propulsion sub-systems (especially very low mass divert systems), miniature inertial navigation units, array image processing, C.G. Control algorithms, fast frame and UV Seekers, acquisition and track; target discrimination, seeker operational environments, lethality/miss distance; aero-optical effects, guidance and fuzing accuracy, shroud separation, window thermal-structural integrity, non-nuclear kill warhead performance, target acquisition in a nuclear environment, performance and survivability of electronics in nuclear environment; HVG lifetime, firing rate, projectile guidance and control and projectile launch survivability; and, common among all systems reliability; producibility, maintainability, and low cost/low mass.

SDIO93-003 TITLE: Sensors

DESCRIPTION: Sensors and their associated systems will function as the "eyes and ears" of a space-based ballistic missile defense system, providing early warning of attack, target identification, target tracking, and kill determination. New and innovative approaches to these requirements using unconventional techniques are encouraged across a broad band of the electromagnetic spectrum, from radar to gamma-rays. Passive, active, and interactive techniques for discriminating targets from decoys and other penetration aids are sought. Sensor-related device technology is also needed. Examples of some of the specific areas to be addressed are: cryogenic coolers (open and closed systems), superconducting focal plane detector arrays (for both the IR and sub-mm spectral regions), signal and data processing algorithms (for both conventional focal plane and interferometric imaging systems), low-power optical and sub-mm wave beam steering, range-doppler lidar and radar, passive focal plane imaging (long wavelength infrared to ultra-violet; novel information processing to maximize resolution while minimizing detector element densities) interferometry (both passive and with active illumination), gamma-ray detection, neutron detection, intermediate power frequency agile lasers for diffractive beam steering and remote laser induced emission spectroscopy, lightweight compact efficient fixed frequency radiation sources for space-based SDI application (uv-sub-mm wave), new optics and optical materials. Entirely new approaches are also sought.

SDIO93-004 TITLE: Nuclear Space Power

DESCRIPTION: Weapons, sensing, and communications systems under consideration for strategic defense have diversified power requirements and a wide spectrum of power and power conditioning situations. Nuclear power concepts and the associated components are of interest for unmanned spacecraft. The power duty cycles to be considered include: hundreds of MW power for pulse applications, sustained tens of kW for electric propulsion, continuous tens to hundred kW power for house keeping, tracking, etc. The energy conversion approaches include thermionic and Rankine cycles. New approaches leading to controlled wide excursions of power and burst mode

power are sought. As part of Topic 93-007, innovative thermal radiator concepts are needed for all types of power cycles. Also, concepts and systems that enhance safety, maintainability, and reliability of space nuclear power systems are sought.

SDIO93-005 TITLE: Non-Nuclear Space Power and Power Conditioning

DESCRIPTION: Along the lines of Topic SDIO93-04, non-nuclear approaches are sought for high energy densities. The power duty cycles to be considered include: hundreds of MW power for burst applications, sustained tens of kW to MW power for electric propulsion, continuous tens of W to a few kW for house keeping, communications, etc. Specific topics include novel very long life battery concepts, chemically driven systems for burst power, advanced solar collectors and high efficiency multibandgap or thin film converters, inductive and capacitive stores, space-based MHD generators, heat dissipation systems, signature control, plasma switches, and high temperature power electronics. Also, concepts and systems that improve maintainability and reliability of space power systems (e.g. low loss insulation and cable) are sought. Very light weight and affordable technologies are also sought as are concepts that can work in the van Allen belt.

SDIO93-006 TITLE: Propulsion and Logistics

DESCRIPTION: Strategic defense places unprecedented demands on all types of space transportation and propulsion systems; launch to low earth orbit, orbit transfer, orbit maneuvering, and station keeping. In particular, advancements are needed to achieve major reductions in the costs of placing and maintaining payloads in the desired orbit. Traditionally, the cost of space transportation and the operation of the spacecraft have been major factors in the determining the life cycle costs of space-based assets. Approaches leading to techniques, methods, processes, and products in support of these propulsion and logistics objectives are sought. Propulsion approaches include liquid, solid, and electric. Advancements are needed in propulsion-related areas, e.g., extending storage time of cryogenic fluids (e.g. Hz and Ze), reduction of contamination from effluent, and sensors and controls for autonomous operation. Areas of interest include the entire spectrum of space transportation and support: efficient launch systems for small technological payloads as well as full system payloads, assembly, and control systems; expendable and recoverable components; improved structures and materials; and increased propulsion efficiency. In anticipation of and solar power demonstration missions incorporating electric thrusters, SDI seeks 10 to 30 kW electric thruster modules (e.g., electrodes, insulators, ignition systems, propellant control, command and control system, thermal management system, and power conditioning unit). With the advent of small surveillance satellites, low power (0.5 to 2 kW) electric propulsion is being considered for station keeping and orbit transfer; for such systems emphasis is being placed on achieving higher power densities for components of the integrated system (thruster, power conditioning unit, fuel control, gimbals, and fuel storage). Low mass interceptors require advances in divert (small thrusters) propulsion systems (either solid or liquid).

SDIO93-007 TITLE: Thermal Management

DESCRIPTION: The high power levels for space stations must dissipate heat at state-of-the-art capabilities for waste thermal energy acquisition, transport, and dissipation to space. Technology advancements are required in thermal management for both power generation systems and space platform payloads. Some space platforms will require years of storage of large amounts of cryogens with minimum cryogen loss and high cryogen delivery rates under condition of zero-g, concept and devices for all types of space-based power cycles, nuclear and non-nuclear, and can satisfy these projected space platform requirements.

SDIO93-008 TITLE: Survivability

DESCRIPTION: The Strategic Defense System elements must survive determined attacks against the system, and the natural space environments (atomic oxygen, space radiation and micrometeorites/debris). Survivability technology is needed for threat sensing, creation of false aim points, and passive hardening. Contributions are sought in novel analytic methods, materials development and processing, component hardware, systems, design and analysis.

Threat sensors enable the defense elements to detect nuclear, laser and radio frequency weapon attacks, and to respond appropriately. Sensors which can characterize the threat according to direction of attack, and spectral characteristics are particularly noteworthy. Technologies to create false aim points are needed to operate against the threat support sensors, including radar, passive visible/IR sensors and seekers, and laser radar.

Passive hardening against the nuclear, laser, RF and pellet/debris environments is needed, in addition to hardening against the natural space environments. SDS elements have common mission critical subsystems. Sensor systems, communications antennas (RF and laser), attitude sensors, solar power, propulsion, structure and thermal control are all directly exposed to nuclear, laser, RF and pellet/debris in addition to the natural space environments. Materials and component designs which are intrinsically hard to these environments, and/or protective devices are needed. A key area is sensor subsystems, the components of which (baffle materials, mirrors, optics, structures, and focal plane arrays/read out electronics) must survive the laser, nuclear and IR environments. Nuclear and laser hard baffle materials, and devices for protection against unknown or agile lasers and rejection of RF energy are of particular interest. Structures and coatings providing appropriate thermal characteristics, stability under mechanical impulses and hardness to laser and RF radiation are needed. Processors capable of operating in unique nuclear environments presented by the strategic application (i.e. multiple burst environments) while retaining full functionality are essential.

SDIO93-009 TITLE: Lethality

DESCRIPTION: A major factor in determining the effectiveness of a ballistic missile defense is the lethality of the directed and kinetic energy devices against responsively hardened targets. Innovative ideas or concepts for measurement of radiation of particle penetration, structural damage due to thermo-mechanical stress, opacities of plasma blow-off. New concepts to produce higher probability of kill-given-a-hit.

SDIO93-010 TITLE: Computer Architecture, Algorithms, and Language

DESCRIPTION: Strategic defense systems for battle management demand order-of-magnitude advances. A system must acquire and track thousands of objects with hundreds of networked sensors and data processors, direct weaponry to intercept targets, and determine the degree of kill. Areas of interest are:

- New computer architectures which are robust, compact, and fault-tolerant, but allow for the extremely rapid processing of data. Architectures may be implemented by new designs or innovative applications of existing technologies, such as optical signal processing, systolic arrays, neural networks, etc.

- Very high-level language (VHLL) design for both the development and testing of extremely large software systems.

- Novel numerical algorithms for enhancing the speed of data processing for sensing, discrimination, and systems control. These may be specifically tailored to a particular system, for tasks (for instance, the execution of a phase retrieval algorithm for interferometric imaging). Includes neural networks.

- Language design to develop code optimized for highly parallel processed architectures.

- Testing techniques that will provide a high level of confidence in the successful operation of concurrent, real-time, distributed large-scale software systems. Examples include sensitivity analysis, data flow testing, mutation testing, static concurrency analysis, and dependency analysis.

- Computer network and communications security. R&D for trusted computer systems in accordance with DoD 5200.28.STD; integration of COMPUSEC with COMSEC (DoD 5200.5).

- Self-adaptive processing and simulation. Algorithms and architectures for advanced decision making.

- Neurocomputing and Man-Machine Interface - rule-based AI and neural networks combined for decision making flexibility and system robustness; development of decision trees and information display for highly automated, short response time, high volume scenarios.

- Software architectures for embedded computer networks that especially facilitate incremental system and software integration, hardware and software maintenance, and system evolution, without significant performance degradation.

- Hardware and software self-diagnostic capabilities for monitoring the operational readiness and performance of space and ground systems incorporating embedded computer networks.

SDIO93-011 TITLE: Optical Computing and Optical Signal Processing

DESCRIPTION: Dense computing capability is sought in all architectural variations, from all optic to hybrid computers. Specific examples of areas to be addressed include, but are not limited to, high speed multiplexing, monolithic optoelectronic transmitters, holographic methods, reconfigurable interconnects, optoelectronic circuits, and any other technology contributing to advances in intra-computer communications, optical logic gates, bistable memories, optical transistors, and power limiters. In particular, non-linear optical materials advancements and new bistable optical device configurations are of interest.

SDIO93-012 TITLE: Structural Concepts

DESCRIPTION: Minimum weight structures are needed to withstand high-g loading, acoustic and thermal environment of ground based interceptors and to provide solid bases for space systems pointing and tracking. Such structures will benefit from : (1) innovative vibration control techniques, (2) innovative fabrication approaches to cut structure cost, and (3) innovative use of advanced materials and/or design approaches to minimize structure weight. For instance, techniques and experimental verification are needed for active and/or passive methods to measure and control vibrations caused by thermo-mechanical flutter, thruster firing or structure borne noise caused by on-board mechanisms. "Active" structural elements containing materials and electronics to provide predictable mechanical displacement in response to applied electrical signals are of interest. Maximization of displacement, mechanical strength, and reliability; parameter stability over extended temperature ranges; and minimization of driving voltage, power, and weight of these elements are desired. Producibility improvements for curved d31 mode

actuator elements, flextensional, and other integrated motion amplifiers are of interest. Fabrication approaches that provide minimum weight with reduced assembly, inspection, and scrap rates for conventional, advanced composite, and "active" structures are needed to reduce costs. Of course, clever design and material usage to reduce structure weight while maintaining or increasing capability are always desirable goals.

SDIO93-013 TITLE: Structural Materials

DESCRIPTION: Many of the anticipated structural advances sought in Topic 91-012 will depend on major improvements in material properties and cost effectiveness. Space structures supporting seekers and antenna must accommodate retargeting maneuvers without detrimental jitter from vibrations and thermo-mechanical flutter. Surface launched interceptors must withstand high g loads, aerothermal heating and structural vibration without compromising tracking accuracy. Lightweight materials are very beneficial for both ground and spaced based systems.

Specific goals require advanced techniques and processes that include imparting oxidation resistance and damage tolerance to composites and creating high elastic modulus composites for use over a broad range of temperatures. The following are sought: (1) innovative manufacturing methods for producing high modulus, fiber-reinforced glass, light metal (i.e., aluminum or magnesium), or resin matrix composites; (2) innovative procedures for the production of instrumentation, sensors and software for on-line process monitoring and evaluation of high modulus, fiber-reinforced composites during fabrication; (3) novel approaches to tailor fiber/matrix interfaces to maximize capability in advanced composites; (4) novel methods to cut fabrication cost of metallic and/or composite spacecraft and interceptor structures; (5) innovative tooling techniques for near-net shape production of advanced composites; (6) novel low-to-no outgassing joining/bonding techniques for advanced composites; (7) innovative surface modifications to promote wear resistance; (8) new methods for integrating instrumentation (e.g., embedded sensors) into advanced composite materials and structures; and (9) novel instrumentation for determination and telemetry of material properties and data from space. Advances are also sought in materials for optical system components, mechanical moving assemblies, and protective coatings.

SDIO93-014 TITLE: Electronic Materials

DESCRIPTION: The necessary advances in electronics for the many strategic defense applications will require advances in electronics materials.. Primary emphasis lies in advancing the capability of integrated circuits, detectors, sensors, large scale integration, radiation hardness, and all electronic components. Novel quantum-well/superlattice structures which allow the realization of unique elective properties through "band gap engineering" are sought as are new organic and polymer materials with interesting electronic characteristics. In addition, exploitation of the unique electronic properties of single crystal diamond is of considerable interest. Among the many SDI electronic needs are advances in high frequency transistor structures, solid state lasers, optical detectors, low dielectric constant packaging materials, tailored thermal conductivity, microstructural waveguides, multilayer capacitors, metallization methods for repair of conducting paths in polyceramic systems, and sol-gel processing for packaging materials.

SDIO93-015 TITLE: Superconductive Materials

DESCRIPTION: SDIO wants to demonstrate both high temperature superconductor (HTS) and low temperature superconductor (LTS) devices to enable or improve strategic defenses. Emphasis in HTS technology is in components integrated with state-of-the-art cryoelectronics for communications systems at K- and V- bands and radar systems in the X-band. The demonstration of HTS materials to BLIP limited detection of radiation in the optical, IR, MWIR, and LWIR bands as well as for signal processing applications is also of interest. The emphasis in LTS technology is the development and demonstration of high sensitivity detectors, digital electronics and memory

enabling on-focal plane array signal processing and operating at temperature greater than 10K. Efforts should address packaging and interface issues and systems integration with cryocoolers and stored cryogens.

SDIO93-016 TITLE: Surprises and Opportunities

DESCRIPTION: Since SDI is an exploration at technology's leading edge, it recognizes that surprises and opportunities may arise from creative minds. SDI will consider proposals in other technologies where they present an unusual opportunity for SDI. The proposer should take special care to describe the technology and why SDI would benefit from exploring it. Proposers should note that proposals in this topic will receive preliminary screening that may reject them as too far afield without the full technical review received by proposals in the topics already listed. This open call is for new technology, not for recycling of old ideas.

APPENDIX A

U.S. DEPARTMENT OF DEFENSE

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM

PROPOSAL COVER SHEET

Failure to use a RED Copy as the original for each proposal and to fill in all appropriate spaces may cause your proposal to be disqualified

TOPIC NUMBER: _____

PROPOSAL TITLE: _____

_____

FIRM NAME: _____

MAIL ADDRESS: _____

_____

CITY: _____ STATE: _____ ZIP: _____

PROPOSED COST: _____ PHASE I OR II PROPOSAL: _____ PROPOSED DURATION IN MONTHS: _____

BUSINESS CERTIFICATION:

	YES	NO
▶ Are you a small business as described in paragraph 2.2?	☐	☐
▶ Are you a minority or small disadvantaged business as defined in paragraph 2.3? (Collected for statistical purposes only)	☐	☐
▶ Are you a woman-owned small business as described in paragraph 2.4? (Collected for statistical purposes only)	☐	☐
▶ Has this proposal been submitted to other US government agency/agencies, or DoD components, or other SBIR Activity? If yes, list the name(s) of the agency, DoD component or other SBIR office in the spaces to the left below. If it has been submitted to another SBIR activity list the Topic Numbers in the spaces to the right below	☐	☐

_____ _____

_____ _____

▶ Number of employees including all affiliates (average for preceding 12 months) _____

PROJECT MANAGER/PRINCIPAL INVESTIGATOR	CORPORATE OFFICIAL (BUSINESS)
NAME: _____	NAME: _____
TITLE: _____	TITLE: _____
TELEPHONE: _____	TELEPHONE: _____

For any purpose other than to evaluate the proposal, this data except Appendix A and B shall not be disclosed outside the Government and shall not be duplicated, used or disclosed in whole or in part, provided that if a contract is awarded to this proposer as a result of or in connection with the submission of this data, the Government shall have the right to duplicate, use or disclose the data to the extent provided in the funding agreement. This restriction does not limit the Government's right to use information contained in the data if it is obtained from another source without restriction. The data subject to this restriction is contained on the pages of the proposal listed on the line below

PROPRIETARY INFORMATION: _____

_____ _____ _____ _____

SIGNATURE OF PRINCIPAL INVESTIGATOR | DATE | SIGNATURE OF CORPORATE BUSINESS OFFICIAL | DATE

Nothing on this page is classified or proprietary information/data

INSTRUCTIONS FOR COMPLETING APPENDIX A

AND APPENDIX B

General

DOD Components employ automated optical devices to record SBIR proposal information. Therefore the proposal cover sheet (Appendix A) and the project summary (Appendix B) should be typed without proportional spacing using one of the following typestyles:

Courier 12,10 or 12 pitch
Courier 71 10 pitch
Elite 71
Letter Gothic 10 or 12 pitch
OCR-B 10 or 12 pitch
Pica 72 10 pitch
Prestige Elite 10 or 12 pitch
Prestige Pica 10 Pitch

Whenever a numerical value is requested type the numerical character (i.e. in "Proposed Duration" type 6 NOT six).

When typing address information use the two alphabet characters used by the Post Office for the state, DO NOT SPELL OUT THE FULL STATE NAME (i.e. type NY not New York or N.Y.).

Complete and SUBMIT THE ORIGINAL RED FORMS bound in this solicitation (not photocopies) as page 1 and 2 of the original copy of each proposal. The completed forms can then be copied for use as pages 1 and 2 of the photocopies of the proposal. The original proposal (with red forms) plus (4) complete copies must be submitted (see Section 6).

Carefully align the forms in the typewriter using the underlines as a guide. The forms are printed to accommodate standard typewriter spacing.

Additional red forms may be obtained from your State SBIR Organization (Reference D) or:

Defense Technical Information Center
ATTN: DTIC-SBIR
Building 5, Cameron Station
Alexandria, VA 22304-6145
(800) 225-3842 (Toll Free)
(703) 274-6902 (Commercial)

U.S. DEPARTMENT OF DEFENSE

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM
PROJECT SUMMARY

Failure to use a RED Copy as the original for each proposal and to fill in all appropriate spaces may cause your proposal to be disqualified

TOPIC NUMBER: _____

PROPOSAL TITLE: _____

_____

FIRM NAME: _____

PHASE I or II PROPOSAL: _____

Technical Abstract (Limit your abstract to 200 words with no classified or proprietary information/data.)

Anticipated Benefits/Potential Commercial Applications of the Research or Development

List a maximum of 8 Key Words that describe the Project

_____ _____

_____ _____

_____ _____

_____ _____

INSTRUCTIONS FOR COMPLETING APPENDIX A

AND APPENDIX B

General:

DOD Components employ automated optical devices to record SBIR proposal information. Therefore the proposal cover sheet (Appendix A) and the project summary (Appendix B) should be typed without proportional spacing using one of the following typestyles:

Courier 12,10 or 12 pitch
Courier 71 10 pitch
Elite 71
Letter Gothic 10 or 12 pitch
OCR-B 10 or 12 pitch
Pica 72 10 pitch
Prestige Elite 10 or 12 pitch
Prestige Pica 10 Pitch

Whenever a numerical value is requested type the numerical character (i.e. in "Proposed Duration" type 6 NOT six).

When typing address information use the two alphabet characters used by the Post Office for the state. DO NOT SPELL OUT THE FULL STATE NAME (i.e. type NY not New York or N.Y.).

Complete and SUBMIT THE ORIGINAL RED FORMS bound in this solicitation (not photocopies) as page 1 and 2 of the original copy of each proposal. The completed forms can then be copied for use as pages 1 and 2 of the photocopies of the proposal. The original proposal (with red forms) plus (4) complete copies must be submitted (see Section 6).

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Defense Technical Information Center
ATTN: DTIC-SBIR
Building 5, Cameron Station
Alexandria, VA 22304-6145
(800) 225-3842 (Toll Free)
(703) 274-6902 (Commercial)

U.S. DEPARTMENT OF DEFENSE

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM

COST PROPOSAL

Background:

The following items, as appropriate, should be included in proposals responsive to the DoD Solicitation Brochure.

Cost Breakdown Items (in this order, as appropriate):

1. Name of offeror
2. Home office address
3. Location where work will be performed
4. Title of proposed effort
5. Topic number and topic title from DoD Solicitation Brochure
6. Total dollar amount of the proposal
7. Direct material costs
   a. Purchased parts (dollars)
   b. Subcontracted items (dollars)
   c. Other
      (1) Raw material (dollars)
      (2) Your standard commercial items (dollars)
      (3) Interdivisional transfers (at other than cost dollars)
   d. Total direct material (dollars)
8. Material overhead (rate_____%) x total direct material = dollars
9. Direct labor (specify)
   a. Type of labor, estimated hours, rate per hour and dollar cost for each type
   b. Total estimated direct labor (dollars)
10. Labor overhead
    a. Identify overhead rate, the hour base and dollar cost
    b. Total estimated labor overhead (dollars)
11. Special testing (include field work at government installations)
    a. Provide dollar cost for each item of special testing
    b. Estimated total special testing (dollars)
12. Special equipment
    a. If direct charge, specify each item and cost of each
    b. Estimated total special equipment (dollars)
13. Travel (if direct charge)
    a. Transportation (detailed breakdown and dollars)
    b. Per diem or subsistence (details and dollars)
    c. Estimated total travel (dollars)
14. Consultants
    a. Identify each, with purpose, and dollar rates
    b. Total estimated consultants costs (dollars)
15. Other direct costs (specify)
    a. Total estimated direct cost and overhead (dollars)
16. General and administrative expense
    a. Percentage rate applied
    b. Total estimated cost of G&A expense (dollars)
17. Royalties (specify)
    a. Estimated cost (dollars)
18. Fee or profit (dollars
19. Total estimate cost and fee or profit (dollars)
20. The cost breakdown portion of a proposal must be signed by a responsible official, and the person signing must have typed name and title and date of signature must be indicated.
21. On the following items offeror must provide a yes or no answer to each question.
    a. Has any executive agency of the United State Government performed any review of your accounts or records in connection with any other government prime contract or subcontract within the past twelve months? If yes, provide the name and address of the reviewing office, name of the individual and telephone extension.
    b. Will you require the use of any government property in the performance of this proposal? If yes, identify.
    c. Do you require government contract financing to perform this proposed contract? If yes, then specify type as advanced payments or progress payments.
22. Type of contract proposed, either cost-plus-fixed-fee or firm-fixed price.

TO: _____

Fill in firm's name and mailing address

SUBJECT: SBIR Solicitation No. 93.1
Topic No. _____
Fill in Topic No.

This is to notify you that your proposal in response to the subject solicitation and topic number has been received by

_____

Fill in name of organization to which you will send your proposal.

_____ _____

Signature by receiving organization Date

Reference B

To: SBIR Participants

SMALL BUSINESS INNOVATION RESEARCH PROGRAM REQUEST FOR DTIC SERVICES

For assistance in the preparation of informed proposals addressing the topics presented in the DoD SBIR Program Solicitation, you are encouraged to request annotated bibliographies of technical reports from the Defense Technical Information Center (DTIC). The cited reports cover selected prior DoD-funded work in related areas. Reasonable numbers of these reports may be obtained at no cost from DTIC under the SBIR Program. You will also receive information on related work-in-progress, and references to other information resources.

Complete the request form, fold, stamp and mail. Please bear in mind that significant mailing delays can occur, please order early.

DTIC authorization to provide this service expires January 15,1993, the DoD SBIR Program Solicitation No. 93.1 closing date.

REQUESTER_____
Name

ORGANIZATION NAME_____

ADDRESS_____
Street

_____PHONE_____
City State Zip Code Area Code/Number

Send technical reports bibliographies on the following SBIR topics:

TOPIC NUMBER	TOPIC NUMBER		TOPIC NUMBER	TOPIC NUMBER
1_____	6_____		11_____	16_____
2_____	7_____	*PLEASE TYPE OR PRINT IN THE*	12_____	17_____
3_____	8_____	*ORDER TOPICS APPEAR IN THE*	13_____	18_____
4_____	9_____	*SOLICITATION*	14_____	19_____
5_____	10_____		15_____	20_____

Company Status: I confirm that the business identified above meets the SBIR qualification criteria presented in Section 2.2 of the DoD Program Solicitation.

This is our first request during the current solicitation: yes____no____.

_____
Signature of Requester

==========FOLD HERE==========

STAMP

Return Address

Defense Technical Information Center
Building 5, ATTN: SBIR
Cameron Station
Alexandria, VA 22304

==========FOLD HERE==========

Associate Directors of Small Business assigned at Defense Contract Management Districts (DCMD) and Defense Contract Management Area Operations (DCMAO):

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Marietta, GA 30060-2789
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(800) 331-6415 (TN, NC, SC, MS, AL, LA, FL)
(404) 590-6196

DCMAO Atlanta
ATTN: Evelyn Taylor
805 Walker Street
Marietta, GA 30060-2789
(404) 590-6062

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ATTN: Lola Alexander
2121 Eight Avenue, N., Suite 104
Birmingham, AL 35203-2376
(205) 226-4304

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1200 Main Street, 640
PO Box 50500
Dallas, TX 75202-4399
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ATTN: John McDonough
495 Summer Street, 8th Floor
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(800) 321-1861 (Toll Free Outside MA)
(617) 451-4317/4318

DCMAO Boston
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Boston, MA 02210-2184
(617) 451-4109

DCMAO Brideport
ATTN: Otis Wade
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(203) 385-4412

DCMAO Buffalo
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1103 Federal Building
111 West Huron Street
Buffalo, NY 14202-2392
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Garden City, NY 11530-4761
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E. Hartford, CT 06108-3234
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(315) 423-5405/5207

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El Segundo, CA 90245-4394
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(800) 624-7373 (Toll Free-AK,HI,ID,MT,NV,OR,WA)
(213) 335-3260

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ATTN: Bob Hobdy
7675 Dagget Street, Suite 200
San Diego, CA 92111-2241
(619) 495-7459/7460

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Seattle, WA 98115-5010
(206) 526-3451

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ATTN: Laura Robello
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Santa Ana, CA 92712-2700
(714) 836-2913

DCMAO Van Nuys
ATTN: Shirley Johnson
6230 Van Nuys Boulevard
Van Nuys, CA 91401-2713
(818) 904-6158

DCMAO Phoenix
ATTN: Clarence Fouse
The Monroe School Building
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Phoenix, AZ 85034-1012
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2800 S. 20th Street, PO Box 7478
Philadelphia, PA 19101-7478
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(800) 258-9503 (Toll Free-DC,DE,MD,NJ,VA,WV)
(215) 737-4006

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Towson, MD 21204-5299
(301) 339-4809

DCMAO Cleveland
ATTN: Herman Peaks
1240 East 9th Street
Cleveland, OH 44199-2064
(216) 522-5446

DCMAO Dayton
ATTN: Betty Adams
c/o Defense Electronics Supply Center
Building 1, 1507 Wilmington Pike
Dayton, OH 45444-5300
(513) 296-5150

DCMAO Detroit
ATTN: David Boyd
905 McNamara Federal Bldg, 477 Michigan Ave.
Detroit, MI 48226-2506
(313) 226-5180

DCMAO Philadelphia
ATTN: Iulia Graciano
2800 S. 20th Street, PO Box 7699
Philadelphia, PA 19101-7478
(215) 737-5818

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ATTN: Fred Fundy
1000 Liberty Avenue
Pittsburgh, PA 15222-4190
(412) 644-5926

DCMAO Reading
ATTN: Thomas Knudsen
45 South Front Street
Reading, PA 19602-1094
(215) 320-5102

DCMAO Springfield
ATTN: Charles Ferraro
240 Route 22
Springfield, NJ 07081-3170
(201) 564-8204

DCMD NORTH CENTRAL (DCMDC-DU)
ATTN: James Kleckner
O'Hare International Airport
10601 West Higgins Road
PO Box 66926
Chicago, IL 60666-0926
(800) 637-3848 (Toll Free)
(312) 825-6020

DCMAO Ceder Rapids
ATTN: Norma Kirkley
1231 Park Place, NE
Ceder Rapids, IA 52402-1251
(319) 378-2009

DCMAO Chicago
ATTN: Norma Thorpe
O'Hare International Airport
10601 W. Higgins Road, PO Box 66911
Chicago, IL 60666-0911
(312) 825-6021/6866

DCMAO Denver
ATTN: Robert Sever
750 West Hampdon Avenue
Building 5, Suite 250
Englewood, CO 80110-2199
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DCMAO Grand Rapids
ATTN: Kay Hamilton
Riverview Center Building
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Grand Rapids, MI 49504-5352
(616) 456-2620

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ATTN: Robert Staton
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(317) 542-2015

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ATTN: Fredric Wolden
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(414) 291-4328

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1222 Spruce Street
St. Louis, MO 63103-2811
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401 N. Market Street
Wichita, KS 67202-2095
(316) 269-7137/7048

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OMB No. 0704-0188

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